THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL

VOL. 60 Thursday, January 26, 1939 No. 1171

PUBLISHED WEEKLY

Subscription Terms : 17s. 6d. per annum.
Foreign and Colonial : 20s. per annum.
All Subscriptions are payable in advance.

All Communications to be addressed to the Editor, the Advertisement Manager, or the Publisher of

THE FOUNDRY TRADE JOURNAL
49, WELLINGTON STREET, LONDON, W.C.2

Telegraphic Address : "Zacatecas, Rand, London."
Telephone : Temple Bar 3951 (5 lines).

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF

The Institute of British Foundrymen

The Institute of Vitreous Enamellers

The Welsh Engineers' and Founders' Association

and

The Foundry Trades' Equipment and Supplies Association

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Floors for Industrial Purposes

We were minded to discuss this subject because to-night Mr. R. Fitzmaurice and Dr. F. M. Lea, of the Building Research Station, are presenting a Paper on the subject to a joint meeting of the Institution of Structural Engineers and the Institution of Chemical Engineers. This subject is of increasing interest to foundry owners, especially those who operate a vitreous enamelling department, where resistance to abrasion, the cause of dust, is of paramount importance. In the foundry itself, there has been an ever increasing tendency to utilise concrete flooring. It shows a real advantage in cleanliness, and freedom from slipperiness, but when liquid metal is spilt on it it "flies." This property is very variable and seems to be a matter of luck. However, there may be some data available which would indicate what type of concrete was the best from this angle. A prolific source of dust production—mentioned in this Paper—is the use of old-fashioned trucks carrying cast wheels, which are skidded around corners. Such types of trucks, for this and other obvious reasons, should be consigned to the scrap heap. Iron and steel plates, if not chequered, are a source of danger through slipperiness, and, moreover, if badly laid additionally so because of their liability to cause tripping. The iron- or steel-plated floor can very easily be kept clean, but its use should be limited to furnace staging and other essential positions. A problem to which we can only see a partial solution is that of keeping the foundry foreman's office reasonably free from sand and dust. Much depends upon its position, but where it is reached by a stairway, then an expanded metal tread forms an automatic scraper. If it be on the ground floor the access should only be possible along a short length of fenced pathway formed by a grating over a trench, the grating to act as an elongated boot scraper. After all, the provision of a properly prepared garden pathway to a cottage does reduce the introduction of dirt, and our suggestion is only along similar lines. The foundry foreman and his staff probably spend more time there than in their own houses. The vitreous enamelling department is best paved with hard wood blocks, but special consideration should be given to those parts carrying the maximum of traffic. Probably a good make of thick linoleum could be used to advantage in these parts. Rubber sheeting seems to suggest itself, but managers of picture theatres have told us that the attachment by adhesives, at least to stairways, is unsatisfactory, and the upkeep costs are high. The Paper contains a very useful table dealing with the effect of various agencies on various flooring materials, including wood, rubber and linoleum sheets. Under the effect of heat and light, wood shrinks, rubber hardens and becomes brittle, and linoleum hardens and cracks; water causes wood to swell, but has little or no effect on the other two. Whilst rubber is resistant to alkali attack, wood is destroyed, and there is some attack on linoleum. Weak acids corrode wood, but have no effect on linoleum or rubber. An examination of the foot of this table confirms our previous remark about the difficulty of sticking down rubber, and apparently the trouble extends to the glues and drying oils which are also used for laying both rubber and linoleums. The problems of the fettling department and patternshop are relatively easy of solution, for in these cases the flooring is of minor importance so long as it carries no obvious deficiencies.

It may not be inappropriate to embrace within this study a few brief notes on roofs, for we are convinced that during the last few weeks many tons of vitreous enamel ware have been impaired through the gales causing the shifting of accumulated dust from the roof rafters on to work in progress. As gales usually blow from the south-west and occur during the late autumn and early spring, architects should be advised to position the shop and strengthen the roof so as to minimise movements and draughts, whilst the foreman should insist that the roof members are cleaned in the middle of October, at Christmas, and at the end of February. We admit these times are somewhat nebulous, but so sometimes is the English and Scottish weather, and they will apply in most years.

D

Institute of British Foundrymen

ELECTION OF NEW MEMBERS

At a Council Meeting of the Institute of British Foundrymen, held at the Queen's Hotel, Birmingham, last Saturday, the following were elected to the various grades of membership.

Members.

L. A. Bentley, foundry manager, J. Berry, Limited, Swinton; A. Burnley, assistant foundry manager, H. Burnley, Bradford; S. Cornthwaite, manager, Cornthwaite & Jane (1938), Proprietary, Limited, Johannesburg; P. N. Davies, Davies & Baird Proprietary, Limited, steel-founders, Victoria, Australia; T. Fujita, assistant naval engineer, Imperial Japanese Navy; C. Galpin, foundry superintendent, Brecknell, Willis & Company, Chard; W. Gibson, foreman moulder, Burn & Company, Howrah, India; E. W. Hale, technical representative, Morgan Crucible Company, Limited, Battersea; J. P. Higham, sales engineer, British Insulated Cables, Limited, Prescot; G. Kent, foundry manager, Sterling Manufacturing Company, London; J. Kirk, sales representative, Hinckleys, Limited, Sheffield; S. N. Loosen, manager, Coronium Metal Company, Limited, Reading; F. R. Pritchard, director, J. Pritchard & Sons, Limited, St. Helens; W. H. Proctor, foundry material manufacturing representative, Newcastle-upon-Tyne; G. D. Prosser, foundry manager, Western Foundries, Southall; R. T. Richardson, sales manager, Midland Monolithic Furnace Lining Company, Limited, Leicester; G. B. Ritchie, sales manager, MacArthur & Jackson, Limited, Glasgow; E. F. W. Smith, chemist, Wellworthy Piston Rings, Limited, Lymington; R. D. Stephen, metallurgist, Eclipse Tube Mill Liners (Proprietary), Limited, Benoni; E. D. Wells, steel founder, Kryn & Lahy, Limited, Letchworth.

Associate Members.

J. Allan, moulder, G. & J. Weir, Limited, Cathcart; H. W. Blackburn, foundry foreman, Low Moor Foundry, Bradford; C. W. Cumber, clerk, R. Thomas & Company, Limited, London; G. L. Fisher, moulder, Walker Castings, Limited, Sheffield; A. Francis, foreman patternmaker, Austral Iron Works, Johannesburg; J. Gorman, foundry foreman, Barr & Company (Brassfounders), Limited, Greenock; H. Haynes, foreman moulder, Ashton-under-Lyne; H. P. Hughes, metallurgist, Grangemouth Iron Company, Limited, Falkirk; J. Hulme, metallurgist, Birmingham Aluminium Casting Company (1903), Limited, Smethwick; P. B. Lake, accountant, Lake & Elliot, Limited, Braintree; H. E. Manderson, moulder, East Rand Engineering Company, Germiston; P. Millington, patternmaker, Metropolitan-Vickers Electrical Company, Limited, Manchester; W. G. Millington, foundry foreman, Hepworth & Grandage, Limited, Bradford; L. N. Mosedale, patternmaker, Leys Malleable Castings Company, Limited, Derby; A. S. Moxon, service engineer, British Insulated Cables, Limited, Prescot; J. Nufton, foreman, W. H. Baxter, Limited, Leeds; G. E. Parramore, patternmaker, F. Parramore & Sons (1924), Limited, Sheffield; F. P. Ramshaw, estimating engineer, Ashmore, Benson, Pease & Company, Limited, Stockton-on-Tees; J. W. Renton, analytical chemist, Sir W. G. Armstrong, Whitworth & Company, Limited, Gateshead; E. C. Retief, foreman moulder, Austral Iron Works, Johannesburg; J. H. Richmond, moulder, G. & J. Weir, Limited, Glasgow; J. Rigby, foreman coremaker, Ashwell & Nesbit, Limited, Leicester; P. Ritchie, B.Sc., assistant secretary, J. & R. Ritchie, Limited, Middlesbrough; D. Robertson, assistant foundry foreman, Ashmore, Benson & Pease & Company, Limited, Stockton-on-Tees; W. L. Robinson, chemist and metallurgist, Central Marine Engine Works, West Hartlepool; S. R. Saini, foundry foreman, Bharat National Foundry, Lahore; F. Shepherd, steel castings inspector, Head, Wrightson & Company, Limited, Thornaby-on-Tees; H. Sorsby, foreman patternmaker, F. Parramore & Sons (1924), Limited, Sheffield; C. Taylor, foreman moulder, Newton Chambers & Company, Limited, Sheffield; S. H. Taylor, cost and works accountant, Davy & United Roll Foundry, Limited, Billingham; W. H. Thomas, foundry foreman, Guest Keen Baldwins Iron & Steel Company, Limited, Port Talbot; J. Timbrell, foundry foreman, Blakey's Boot Protectors, Limited, Leeds; R. T. Turner, foreman, Turner Textile Machine Company, Limited; A. Weightman, foundry foreman, Worthington-Simpson, Limited, Newark; D. Wilson, foreman moulder, Babcock & Wilcox, Limited, Renfrew; H. G. Winnard, foundry draughtsman, Crane, Limited, Ipswich.

Associates.

S. Newman, loam moulder, Jarrow Metal Industries, Limited, Jarrow; J. Ridley, moulder, Jarrow Metal Industries, Limited; J. Slater, Snr., coremaker, Jarrow Metal Industries, Limited.

Students (Associates).

A. Bartley, apprentice iron moulder, Consett Iron Company, Limited, Consett; J. F. Bowles, apprentice patternmaker, Evans' Titan Foundry Company, Cardiff; J. Sanderson, apprentice moulder, Consett Iron Company, Consett.

Correspondence

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Stellite

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—We note on page 86 of the January 19 issue of THE FOUNDRY TRADE JOURNAL, under the heading "Catalogues Received," a reference to tool tipping. We should like to point out that some misapprehension may be caused by this title as metal cutting tools are tipped by brazing on a tip of Grade 40 Stellite cutting metal and not by applying a layer of Stellite by means of a rod and the oxy-acetylene flame. This latter method is applicable to hard facing for wear and corrosion resistant purposes.

The Deloro Smelting & Refining Company, Limited, of Birmingham, are the sole suppliers of Stellite in this country.—Yours, etc.,

M. RIDDIHOUGH.
(Metallurgist, Deloro Smelting & Refining Company, Limited.)

Highlands Road,
Shirley,
Birmingham.
January 24, 1939.

Some Notes on Machine-Moulding

(Concluded from page 96.)

moulding method. When the mould is parted the two halves are placed with the mould uppermost and the loose plates on each half are unbolted and removed. The two halves are then placed together so that the sand edges disclosed by the removal of the plates are brought together, and the bolts are passed through the lugs to make one half mould. The normal plaster frame is then fixed through the centrally-placed pin-holes, and when cast it gives a perfectly reversible plaster-cast pattern-plant. The accuracy of the box part ensures that the completed pattern-plant cannot be mismatched.

In conclusion, the author wishes to acknowledge the loan of lantern slides from Mr. Wardle; J. W. Jackman & Company; Adaptable Moulding Machine Company; British Moulding Machine Company, and Mr. Edward Stevenson.

Random Shots

Reference last week to the publication of the early minutes of the Manchester Association of Engineers has brought an interesting letter from one of its oldest living members. As a young engineer in Manchester over fifty years ago, he used to spend his Saturday evenings at the Grand Hotel at the meetings of this society, which he still remembers as being "homely meetings, with discussion open and free and of great practical value." Sir William Fairbairn might complain that Manchester was almost without a lathe when he first went to work there in 1813, but this correspondent points out that as late as 1887 he went to work at a very reputable and sizeable firm in Sheffield, whose works did not possess a single lathe, even at that date. Himself the son of a prominent Manchester engineer, he adds the interesting fact that his own father was one of the first men to visualise a lathe with an all-drive headstock. It was also his father who equipped the engineering department of the Manchester Technical School, and who ran it for a short period under the guidance of his friend Mr. John Craven. He talks with just pride of having driven a locomotive from Bolton to Preston over fifty years ago at a speed of 90 miles per hour.

* * *

Extract from a daily newspaper, having gone all technical: "Later M. Campinchi proceeded to solder and rivet the first two plates of the 'Clemenceau' (a new battleship). He wore a solderer's asbestos mask and smoked glasses." Would he not have done better to wear a welder's helmet and to have smoked a caporal? Earlier in his speech M. Campinchi said: "We hand to the battleships 'Richelieu' and 'Clemenceau' and to all our war fleet the defence of our Empire, which must remain invincible"—But not if its battleships are stuck together with bits of solder!

* * *

Knowing the Oriental tradition of extreme politeness embodied in flowery language, the secretary of a British business house finished his letter to a Chinese customer thus: "May Heaven preserve you." "And may God pickle you, too," came the reply from China.

* * *

A man was arrested on the Continent for declaring in public that it was a rotten government. "But I never said what government," he retorted. "Never mind," came the reply; "I know very well what you mean, because there is only one rotten government."

"MARKSMAN."

Steel for A.R.P.

INITIAL ORDER PLACED

Arrangements have now been made between the Air Raid Precautions Department of the Home Office and the steel industry for the supply of the steel shelters which Sir John Anderson, Lord Privy Seal, announced on December 21 would be provided by the Government for the protection, in their own homes, of occupants of small houses against blast and splinters from bombs and the falling *débris* from damaged buildings.

An initial order for 120,000 tons of steel sheets, channels and accessories, sufficient to make 400,000 "unit shelters," has been placed. Further orders will follow as the productive capacity of the industry comes into full play. The steel industry is organising the work so that it can be undertaken by mass-production methods, spread over all works capable of undertaking manufacture, which will begin at once.

The shelters are constructed of 14-gauge galvanised corrugated steel sheets with 5-in. corrugations, and have been subjected to rigorous tests to ensure that their strength can resist the weight of *débris* that might fall upon them. Distribution to the households will be undertaken by a special organisation which is being set up by the railway companies.

Some Notes on Machine-Moulding*

By B. GALE

The term "moulding machine" is a rather misleading name, as any machine in the process of moulding is so called, and the completely automatic machine for the manufacture of moulds is not yet designed. The skill of the foundryman is required in some degree on all the different types of machines. The moulding skill of the craftsman is not so important in the case of the machine moulder or operator, but that skill is not discarded; it is placed to a much greater degree on to the shoulders of the foundry executive and the patternmaker.

The foundryman responsible for deciding upon the method of moulding, running, type of machine, type of pattern equipment, etc., must have an all-round practical and technical experience in the foundry. He must be able to visualise the complete range of operations of manufacture of the castings when making his decision on the type of pattern, particularly in the case of pattern plant for large-quantity production. Such a plant may easily cost upwards of £100 and require several weeks to make, and such equipment cannot be left to chance as to whether it will be successful. The foundryman must confer with the patternmaker to decide upon the type of plant required, and with the core-shop foreman to give his ideas upon the coremaking methods to be adopted. If the job offers difficulties in moulding, the co-operation of the designer should be sought, and the foundryman should put forward his suggestions of alteration in the design to overcome those difficulties.

Views are often expressed of the lack of interest and assistance on the part of the designer and draughtsman. Founders have grumbled that the designer never considers the moulding of the particular casting he is designing, and so on. That is not true, and the sooner founders admit it, the better. The trouble is that foundrymen are too conservative; some of them are still in the dark ages and try to keep the utmost secrecy of their methods. They grumble about the design or the pattern and they never, or at least

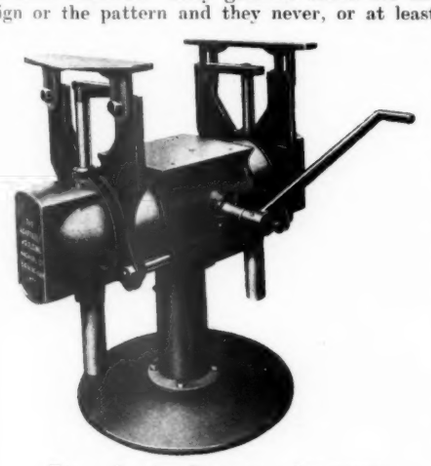


FIG. 2.—A PATTERN STRIPPING MACHINE. COURTESY ADAPTABLE MOULDING MACHINE COMPANY.

very seldom, tell the designer or the patternmaker what they require. They expect the designer to be an expert foundryman capable of designing every job from the point of view of easy moulding.

It must be realised that the designer is skilled in his own particular branch of engineering and that the design he puts on paper is drawn from the point of view of the working efficiency of the machine to be built. It is quite possible that the design can be altered to facilitate moulding without impairing the ultimate efficiency of the job, and it is personal experience that the designer is ready and willing to alter

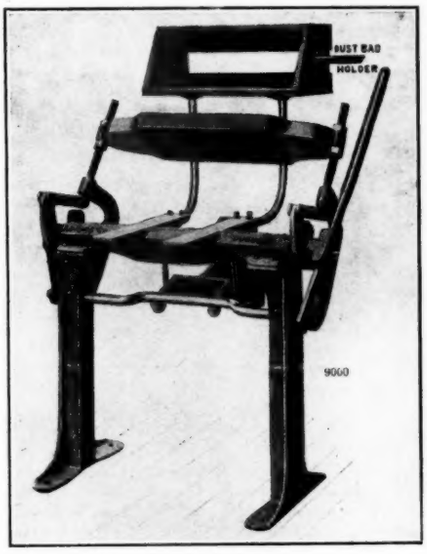


FIG. 1.—PLAIN SQUEEZE MACHINE. COURTESY J. W. JACKMAN & COMPANY.

his design in such cases if the foundryman will put forward his suggestions.

Types of Machines

The moulding machine has been used in foundries for many years, but the real movement towards machine-moulding was brought about by the necessity of production during the Great War, from which time the author's own experience has been garnered. The evolution of the present-day machine can be traced from the sand oddside of the floor-moulder, in which the moulder eliminated some of the unnecessary labour of jointing each individual mould from the solid pattern. Following the sand oddside came the cast plate and the split patterns mounted on either side of a flat plate, incorporating box-pin holes, whereby all the jointing was formed by the plate and the withdrawal of the pattern from the mould was facilitated by the aid of the box-pins.

Plain Squeeze Machines

A simple press for the ramming of the sand, such as is shown in Fig. 1, can be regarded as the first type of moulding machine. The pattern equipment is a double-sided match-plate, either a cast plate or flat plate, with patterns mounted thereon, and is exactly similar to the ordinary plate moulding. The sand is squeezed into the moulding box or flask by the headstock, which is operated by hand leverage. Moulds from this type of machine are placed on the floor on bottom boards. The complete flask is placed on the machine table with the pattern-plate located on the flask pins between the two half-flasks. The bottom half is filled with sand and the bottom board pressed into the sand by hand pressure, and the flask is then rolled over and the top half-flask filled. The presser board is then placed on the sand and the squeezer head pulled over the flask. Pressure is applied by the lever, which rams top and bottom half-moulds simultaneously.

The only operation of this machine is the squeezing, all other operations being the same as plate moulding by hand. This type of machine is particularly suitable for shallow work, and unless the patterns have a large degree of taper, it is not to be recommended for patterns over 2½ in. deep in each half mould. This type of machine will take moulds up to about 30 in. by 18 in.

Hand-Ram Pattern-Draw Machine

This type of machine, shown in Fig. 2, is designed solely for the purpose of withdrawing the pattern from the mould, all other operations being done by hand. This appears to be a retrograde step from the previous type, inasmuch as it necessitates a return to hand ramming of the sand, which is the most laborious job in the foundry. It claims its advantage over the press by having a mechanical pattern-draw. The pattern-plate is single-sided for making one half-mould, and is mounted on machine slides, which are operated by a cam and lever action to withdraw the patterns downwards from the mould. The moulding box is supported on the side-members of the machine. This method gives a very even and steady withdrawal of the pattern and will take jobs up to 6 in. depth of pattern-draw. These machines will take boxes of any length, and by a screw adjustment on the barrel of the machine the width can be adjusted to take boxes from 12 in. to 20 in. wide. This is a very useful type of machine for stripping plate work, the stripper being fixed to the machine side frames and the box part resting on the stripping plate.

Turnover Mechanism

The previous machine, whilst being quite suitable for many types of castings, would not produce moulds having deep cods or hanging pockets of sand, and so the machine shown in Fig. 3 is supplied with turnover attachment to be fitted on to the existing machine sides. When the attachment is used, the moulding box rests on the pattern-plate whilst in the ramming position. For turnover the box is secured by spring grips fitting over the box-pins. The original pattern-plate slides are now used as a mould carrying table to lower the mould away from the pattern. Double-sided pattern-plates can be

FIG. 3.—HAND-RAM TURNOVER MACHINE. COURTESY ADAPTABLE MOULDING MACHINE COMPANY.

used on this machine, so that one half-mould is made to each revolution of the pattern-plate. This machine will take boxes from 12 in. to about 20 in. square.

Fig. 4 shows another type of turnover machine, which, being a sturdily-built machine, will take fairly heavy moulds. All moulding operations are done by hand, on one side of the machine. A board is then placed on the mould and the box is clamped by a special clamp attached to the

* Paper read before the East Midlands Branch of the Institute of British Foundrymen. Mr. R. Spriggs presiding.

machine. The whole equipment is then swung over to the opposite side of the machine by hand, the weight being assisted by strong springs, which are adjustable to take the weight of varying moulds. The board and mould come to rest on the self-aligning arms of the pattern-draw device. The clamp is released and the mould drawn down from the pattern by foot-pressure on the lever, and the pattern-plate swings back to the ramming position. This type of machine will take boxes up to about 30 in. by 20 in., and a pattern-draw up to 11 in., and is exerted by hand leverage, and the pattern withdrawal is by the four-pin method of lifting the mould upwards from the stationary pattern-plate. Lifting arms are controlled by a handle attached to a cam and lever system. The machine will give a pattern-draw up to 8 in. deep. The size of the moulds on the varying types of machines is governed by the minimum position of the lifting pins. On the large machine, for instance, the minimum size of box is 15 in. square. This type of machine is quite suitable for stripping plate work.

FIG. 4.—TURNOVER MACHINE FOR HEAVY MOULDS.
COURTESY J. W. JACKMAN & COMPANY.

very useful for castings having deep cods or pockets.

Hand-Ram Roll-Over Machine

Fig. 5 illustrates a useful roll-over machine for small jobs, taking moulds up to about 16 in. square. Its outstanding advantage is for deep moulds, as it will give a 12-in. pattern-draw. The mould is drawn downwards and the pattern-plate upwards simultaneously. All moulding operations are by hand.

Hand-Press Machine

The type of machine illustrated in Fig. 6 is made in several sizes to accommodate moulds

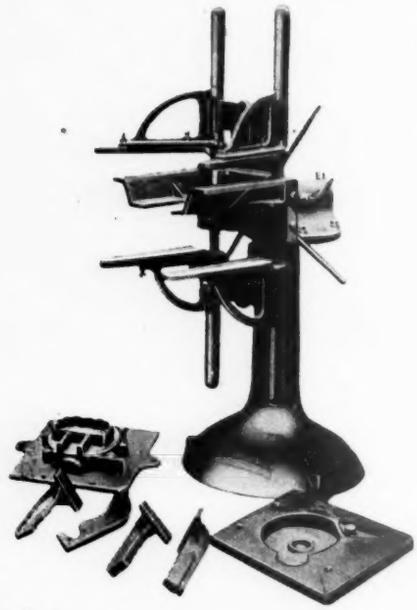


FIG. 5.—ROLL-OVER MACHINE.
COURTESY ADAPTABLE MOULDING MACHINE COMPANY.

from about 12 in. square to 30 in. by 20 in. The chief features of the machine are its simplicity of design and ease of operation. The head of the machine is easily adjustable to take varying depths of moulds. The ramming is

Fig. 7 shows the Adap-squeeze machine, which is another type of hand-press machine, which is exactly similar in operation to the hand-ram machine illustrated earlier, but with the addition of a press head operated by hand leverage.

Fixed-Head Power-Press Machine

In the early types of compressed-air turnover machines, the ramming is exerted by the pattern-plate with the box part and sand extension frame being thrown upwards to a fixed ramming block. This type of ramming is not now used on any of the power machines, but it had one advantage that is missing from the modern machines, *i.e.*, the hardness of ramming could be definitely controlled according to the number of times the mould was bumped. Turnover is effected by hand, the box being secured by clamps affixed to the machine, over the box handles. The mould is drawn downwards from the pattern on an air-controlled table. The machine gives a pattern-draw of 6 in., and is rapid in operation. Its greatest disadvantage is that it is limited to size of mould, one particular machine being designed to take boxes 18 in. by 14 in.

Simple Jolting Machines

These are one of the most popular types of jolt ramming machines. The machine will take varying sizes of mould up to the limit of the pin lift device for size, and according to the cylinder size for weight. The machine is made in various cylinder sizes, so that this type of machine can be obtained to take from small to large moulds, and it is one of the most useful types of machine for taking jobs with deep pockets to be lifted on the stripping-plate method.

The jolting arrangement on some machines has the disadvantage that it does not completely ram the mould. Whether on the upright or the turn-over type, the mould, after being jolted, has to be flat-rammed and strickled by hand, which occupies as much, or more, time than the ramming by jolting. This led to the introduction of the present-day machines, which incorporate both jolting and squeezing and can be used in either capacity or with the combination of both methods. Fig. 8 shows one of the most recent types of upright jolt-squeeze machines. This has the pin-lift method for pattern withdrawal. Fig. 9 shows a modern jolt-squeeze roll-over machine, which is one of the largest of its type and will take deep moulds up to 12 in. pattern-draw.

Choice of Machine

The types of machines to be used by the individual founder must be decided by the founder himself, depending upon his particular class of work and types of pattern plant available. Although the different types of machines have been dealt with in their order of introduction, it is not desired to give the impression that the original machines are out of date and that one must purchase the more modern machines. All the types of machines shown are still in daily use, and each has its own particular advantage according to the type of work to be produced. Each foundry should have a range of different types of machines to meet the many varying kinds of castings made in that foundry.

Again, the question of hand machines or power machines is one that can only be decided by the type of work to be made, and it should not be inferred that on all jobs the power machines are necessarily a means of greater output and reduced costs. For instance, a simple shallow job on a double-sided plate will be made much more quickly and economically on the simple press shown in Fig. 1 than on the power roll-over machine. Cases are known where

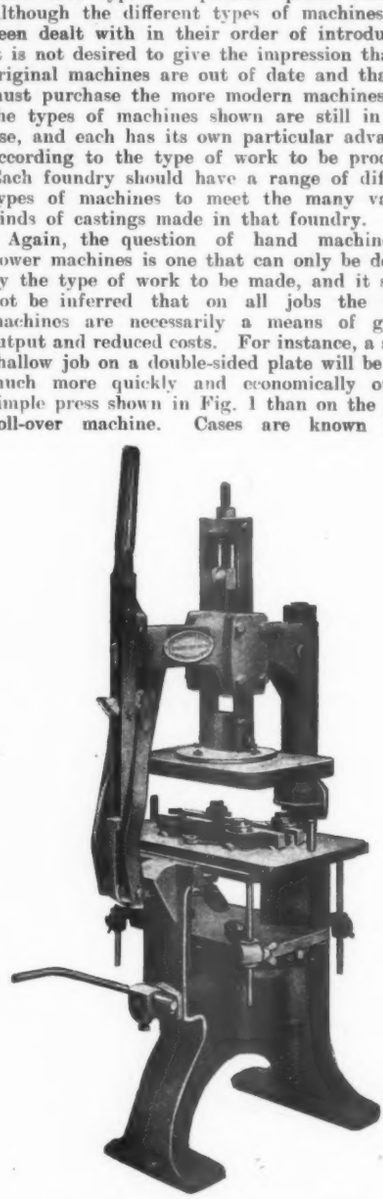


FIG. 6.—HAND-PRESS MACHINE.
COURTESY J. W. JACKMAN & COMPANY.

pattern-plants originally laid out for power machines have been transferred to hand machines with improved results.

One of the most important features lies in the type of pattern-plant to be employed, and considerations of strength and weight are very important. For instance, on the hand turn-overs, lightness is of far more importance than on the power turn-overs, and conversely strength and robust design are far more important on the power machines than when hand-ramming is employed. Pattern equipment forms the principal part of machine-moulding, and methods of making pattern-plants and the materials used were fully explained by S. A. Horton in his recent Paper*; it is not proposed, therefore, to recapitulate by giving descriptions of pattern-plants.

* FOUNDRY TRADE JOURNAL, Vol. 57, 1937, pp. 393-6 and 417-8.

Materials Used in Pattern-Plant Construction

This aspect will be dealt with from the point of view of the use of the patterns on moulding machines.

Cast iron is the most popular of all pattern materials, having strength and rigidity, and also the advantage of being cheap. It is not unduly subject to corrosion, and with ordinary care will last a lifetime. Its disadvantages are excessive weight in the case of hand-lifted jobs and it is somewhat costly to clean up in the metal patternshop. For large quantity production, this cost is not serious, as the cost per piece is very low when spread over large numbers.

Aluminium alloys have strength and rigidity coupled with lightness, and this last feature is the greatest asset. Although the material cost is high, the working cost in the patternshop is lower than for cast iron. The material does present some difficulty in working, due to its clogging files and grinding wheels. The great disadvantage is that the metal is easily bruised and is subject to an extreme amount of pitting and corrosion, particularly when patterns are stored away.

Brasses and bronzes are strong, rigid materials and have the added advantage of being rust resisting. Material cost is high and the pattern working cost is similar to that of cast iron, whilst the patterns are heavy. The outstanding advantage is the very fine finish obtainable for such jobs as the thin fins of air-cooled cylinders.

White metal is moderate in price, being half way between cast iron and bronze. The greatest advantages are ease in patternshop working and the finish obtainable; but these are dependent upon the foundry when making the metal patterns. The temperature of pouring must be low, for if the material is cast too hot the patterns will be so rough that it would be cheaper to melt them and remake, rather than to attempt to clean them. If cast cool the patterns will leave the sand in a condition to be

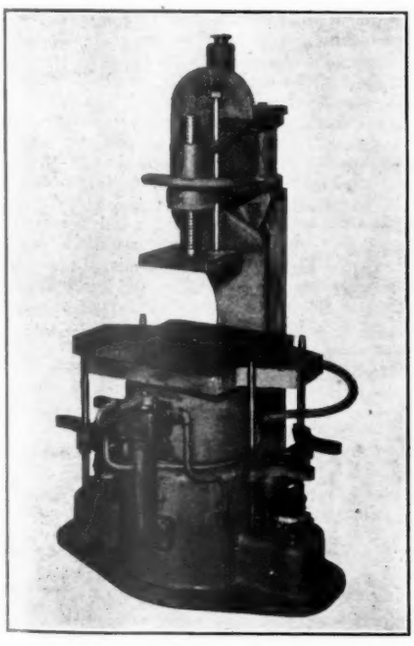


FIG. 8.—JOLT-SQUEEZE MACHINE. COURTESY BRITISH MOULDING MACHINE COMPANY.

smooth enough for moulding without filing. Such patterns can be burnished on a revolving wire brush. The material is rust resisting and non-corrosive. Certain mixtures of white metal are non-contracting and are therefore very usefully employed in the production of extra patterns from a single-contraction pattern. The material is very heavy, and has the added disadvantage of being easily bruised, and thus requiring extra care in storage and in working in the foundry. It is most useful for the quick production of pattern-plants for moderate quantities.

Non-Metallic Materials

Stone compounds are useful for any type of oddside or for full pattern plants. They are fairly strong in bulk but inclined to be brittle in thin sections; thus it is advisable to make such parts in metal to be inserted into the mould before pouring the main part of the pattern-plant. These materials are generally subject to expansion in use and require periodical atten-

FIG. 7.—HAND-PRESS MACHINE. COURTESY ADAPTABLE MOULDING MACHINE COMPANY.

tion and scraping to avoid mould crushing or flashings, etc. Metal patterns or inserts of iron, steel or aluminium cause a chemical reaction with the stone material, which results in a blistering corrosion at the junction of the metal and the material. This is particularly severe in the case of aluminium, and the author does not recommend the use of this metal with stone materials. The corrosion with iron and steel is very slight. The corrosion can be prevented to a certain extent by coating the metal inserts with an insulating paint on the portions that come in contact with the material. Brasses and lead-base metals do not cause corrosion. Stone materials require particular care and technique in mixing, but this can be readily acquired, and they are generally productive of good pattern plants. They are sufficiently strong for ordinary foundry working and will withstand the shock of power jolting and squeezing machines. They are rather slow in setting sufficiently to be worked, and about two days must elapse before an average-sized cast is lifted from the mould for cleaning.

Plaster of Paris is generally used for oddsides in the same manner as the stone materials, but is of a much weaker nature and is useless where power jolting and squeezing is to be employed. It is very useful on the hand-ram and hand-squeeze machines. The cheapness and ease of working make it admirable for layouts of small and medium quantities. It is also very useful when time is of major importance, as such plants can be run, cleaned, varnished and in work inside an hour.

Plaster in conjunction with the white metal can be productive of a complete pattern plant in a shorter time than any other materials. The following is an actual case. An order was received for 200 castings at 8.30 a.m., the customer supplying one single-contraction wood pattern. Four white-metal patterns were made from the wood pattern and a white-metal runner-pattern. These were then moulded in a 12-in. square box and plaster frames fitted and run in plaster. The drag half had the white-metal pattern cast in the plaster, and the cope half was all plaster. The plant was cleaned and varnished and the 50 odd moulds required to supply the 200 castings were made and cast by 5.30 p.m. on the same day. This was obviously an exceptional case and one that could not be carried out as a normal foundry routine, but it does illustrate the particular advantage of plaster and the speed that can be obtained when the circumstances warrant it. Plaster can be purchased in a number of grades, from the very fine white as used in medical surgery to the very coarse pink used for building roughing, and in personal experience the second-grade white has been found the most suitable for pattern-plant work.

Pattern-Plates

Pattern-plates for double-sided plates for the hand-lift types of machines must be strong and rigid but not of excessive weight, and they should be made as thin as possible. For plates up to about 22 in. by 12 in. the thickness need be no more than $\frac{1}{4}$ in., and for this class of job the steel plate ground flat on both sides is the most suitable. For single-sided plates on the hand-ram, hand-press or power machines, cast iron is the best material and should be planed on both sides. Oddside frames should be of cast iron, flanged and ribbed to give strength and support for the retention of the plaster or stone material. Frames should be planed on both faces. All plates and frames must be jig-drilled to ensure accuracy of box-pin centres, and, when pin boxes are to be used, the pin holes in the pattern-plates should be bushed with hardened steel bushes. If loose-pin boxes are to be used, this is not necessary, as the pin is then fixed in the plate, and when once fixed becomes part of the plate. Each plate should have its own new set of pins. It is false economy to have a few sets of pins and change from plate to plate as required. It is essential to lay down a definite standard for pin sizes, so that all plates and boxes throughout the foundry have the same size of pins and holes. Pins in the plates should have a clearance of 0.002 to 0.003 in. on the pin diameter. Assembling pins for loose-pin boxes

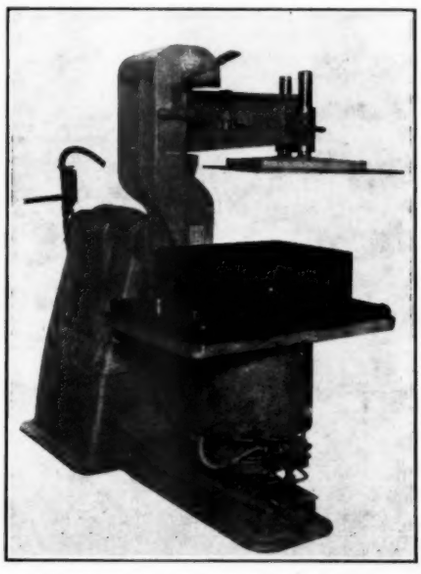


FIG. 9.—JOLT-SQUEEZE ROLL-OVER MACHINE. COURTESY BRITISH MOULDING MACHINE COMPANY.

will require a little more tolerance, and a clearance of 0.006 to 0.007 in. should be allowed.

Box Parts and Flasks

Box parts in repetition work form one of the most important and, incidentally, most expensive items. They have to be strong to withstand a considerable amount of rough handling in conditions that are anything but ideal, and they

must not be so heavily constructed as to form a hindrance to production on account of excess weight. Steel boxes are nowadays most commonly used. The original claims for the steel moulding box were lightness and freedom from breakages when compared with the cast-iron box. The use of these boxes on power-press and hand-press machines quickly distorted the boxes, to cause their rejection, and the boxes are now made in heavier and specially designed sections so that there is little difference in the weight as compared to cast-iron boxes of similar size. They certainly do stand up to the claims of no breakages, but even so the troubles of bad lifts due to distorted boxes may arise, and they require some supervision in maintenance to keep them in working condition. The cast-iron box does not give this trouble, as it will not bend and distort. Whilst it is whole, it is a good box.

Small boxes, say 12 or 13 in. square, can be machine-moulded in one's own foundry very cheaply, and the author has made hundreds of these small boxes for machine-moulding, fitted with renewable bushes for loose-pin working. The box lugs were cored with chamber cores. The boxes were machined on both edges and were then placed over a pin jig and a brass-tube bush cast into the chambered lugs with babbit metal. In this way the boxes were interchangeable and could be used for a two-, three- or multi-part mould. The brass bushes were very cheap and had the advantage of being rust resistant. When worn it was a simple matter to melt out the old bush and insert a new one. The boxes were cast ¼ in. thick, and several hundreds were in daily use for 12 to 14 years, and the breakages were negligible.

One other important feature regarding box parts in the repetition foundry is the number of different sizes in use. This should be kept to an absolute minimum. The labour entailed in box-part changes each time a new job is placed on a machine can reach a disconcerting amount in the course of a year. It is far better to arrange the lay-outs to suit a limited number of box-sizes. In a recent lecture mention was made of a foundry that had over 800 sizes of boxes, which were eventually reduced to 55 sizes. A personal opinion is that it would be preferable to see this number again reduced to a dozen sizes.

Flask Moulding

Flask moulding is used by a good many repetition foundries, and the great advantage lies in the reduced amount of capital outlay in box parts and the saving in labour in knocking-out, stacking and storage of the boxes. Flask moulding requires a different technique from that when boxes are employed, and a personal opinion is that the causes of waste castings are higher when flasks are used. Probably the most important feature of flask moulding is that a greater margin between pattern and flask must be allowed to prevent burst-out troubles when pouring. Support of the mould when pouring is generally allowed for by one of two methods: (*a*) bands rammed up in the flask at the joint of the mould, and (*b*) slip jackets to place over the mould whilst pouring. Both methods have their advantages and disadvantages. Method (*a*) necessitates the supply of a large number of bands, which somewhat offsets the saving in box parts and labour. Method (*b*) requires only about a dozen slip jackets for each moulder, as they can be moved over whilst pouring proceeds, but there is more chance of waste due to disturbed moulds when the jackets are being placed over.

Snapflasks are successfully used on any type of hand-ram or hand-squeeze machines, and on the plain jolting machines, but they have not yet been found suitable to withstand the more severe conditions of the power jolt-squeeze machines.

Pattern Lay-out

The lay-out of patterns for repetition moulding is the most important aspect of production. The necessity of correct planning of the job before the patterns are commenced cannot be over-emphasised. The very design of a moulding machine demands good pattern equipment, and all the features must be accurately prepared so that moulds leave the machine successively without any trouble due to broken moulds on pattern withdrawal. It should be remembered that the castings are to be produced quickly with semi-skilled labour, and a few shillings spent on patterns will save many pounds on production. Every casting has its own particular problems and must be considered when deciding the type of pattern to be produced. The following considerations must be made and tabulated when quoting for the job.

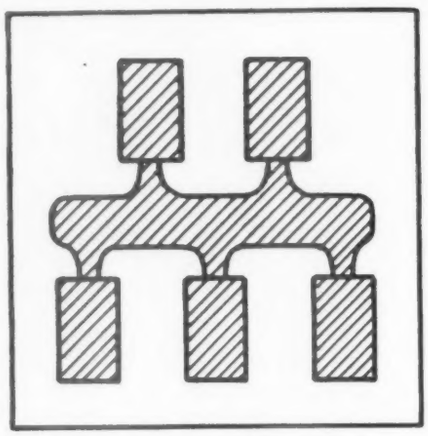


FIG. 10.—REVERSIBLE PATTERN-PLATE.

(1) Is it to be made green sand, dry sand, or made up of cores?

(2) Is the job to be made completely by one operator, or is it better to have two, one working on copes and the other on drags?

(3) It may be necessary to have three operators, two making the moulds and the third coring and closing.

(4) Is it cheaper to make a core assembly job, or a three- or four-part mould?

(5) What size of box or flask is required, and how many patterns in a box?

(6) What type of machine is required for the lift? In the case of castings with deep cods or pockets consideration must be given as to whether it would be cheaper on a rollover machine or on a straight lift machine supporting the pockets with sprigs or lifters. In the latter case the number and sizes of sprigs and lifters required must be specified. Chills, denseners, chaplets, etc., must all be specified and the sizes, quantity and positions recorded.

(7) What sizes of sieves or riddles are required?

(8) Is venting required? If so, state where.

(9) Are boxbars necessary? State sizes, number and positions.

(10) State type of runner required, giving sections of ingates and trough, and whether one or more sprues are required. In the latter case, state whether the job is to be poured by one or more pourers.

All this information should be recorded on a drawing of the lay-out so that the patternshop, on receipt of the order, can proceed and produce the pattern-plant in accordance with the method for which the job has been quoted. On completion, the pattern-plant must be tried out on an experimental basis, which should be as far as possible identical to the production conditions, so that any errors or omissions can be found and rectified before the job goes into production.

Wherever possible, it is advisable to have a complete lay-out for each particular type of casting. In the repetition foundry, mixed lay-outs, whilst showing a saving on original pattern cost, can be a very difficult problem if the customer should call for a quantity of one type only and the plant has two or three different types on the plate.

The foregoing remarks on pattern lay-out are a comparatively simple matter in the purely repetition foundry which makes its own pattern-plants, and where the quantities are so large that the spreadover of pattern cost is of minute importance. It is, however, a very different matter in the foundry that tackles smaller quantities on moulding machines; and it is now proposed to spend a little time on the question of machine-moulding in the jobbing foundry, which generally produces its castings in moderately small quantities from customers' patterns.

The application of machine-moulding should be introduced into practically every foundry. There are but few shops, even the smallest, that do not have some orders for which machine-moulding would show a saving against hand moulding. This statement may prompt the question, "What is the minimum quantity for machine-moulding?" This can only be answered when one has knowledge of the patterns available; obviously, if a customer is supplying the pattern and such pattern could not be mounted on a plate without expensive preparation, the quantity must be sufficient to cover such charges.

Generally speaking, however, on flat-back patterns, or split patterns that can be mounted on to a standard machine-plate, large quantities are not essential, and in small moulds, say 12 in. square up to 20 in. by 12 in., the job is worth mounting on a machine for a quantity as low as 12 moulds. Personal practice in such cases was to mount the pattern on to a standard machine plate. The machines were of the hand-ram or hand-squeeze types. As far as possible, only one size of moulding box was used on any one machine, so that an operator might make one, two, three or more different jobs in a day without having any change of box parts. The machine was fitted with a special frame to receive the pattern-plates, and the box pins were fixed in the frame. The plates were, therefore, plain rectangular plates, machined both sides and all edges. The plates were a push-fit into the machine frame, and secured at the corners by recessed cheese-head screws.

If the pattern design was symmetrical, only one half-pattern was mounted and the copes and drags were made from the one plate. When two plates had to be used, the method was to make all the drags, then change over the plates and make all the copes. As far as possible, it is an advantage to make the pattern-plates reversible for making copes and drags, so that changing is brought to a minimum and moulds can be closed as the work proceeds. Many split patterns can be arranged to make two in a mould from the one plate. When the pattern cannot be worked reversible, it is necessary to have two plates, and find another job to go with it to fill up the box. If the order warrants it, say 50 or 100 off, then an extra pattern could be made in the non-contracting white metal previously referred to, to make two castings per box.

Reversible Plates

When making small flat-back castings, the reversible plate shown in Fig. 10 for copes and drags is to be recommended to get the maximum number of castings in a mould, in addition to a saving on pattern cost. When plaster or stone-compound pattern-plants are necessary, the reversible method should be utilised where possible, so that a complete layout can be made with minimum cost. To make these reversible plants a specially-designed box part was used to make the mould.

The box is made half-size of the standard pattern-plant and has three pin-lugs on cope and drag, two on the ends and one in the dead centre of one side. The other side is a loose member, machined to an accurate fit and secured by bolts through lugs. The loose pattern is moulded and jointed by the normal loose-pattern

(*Concluded on page* 92.)

The Randupson Process

BIRMINGHAM DISCUSSION ON MR. F. W. ROWE'S PAPER

There was a large attendance of members of the Birmingham, Coventry and West Midlands Branch of the Institute of British Foundrymen at the last month's meeting in Birmingham, when the Paper on "The Randupson Process," by MR. F. W. ROWE, B.Sc., was discussed. This Paper, it will be remembered, was presented to the Bradford Conference and was printed in our issue of June 23, 1938. In the course of this presentation the following supplementary information was given by Mr. Rowe.

In foundry practice, as in every other branch of engineering and metallurgical industry, technique is always undergoing improvement and innovations are being introduced. Most of these, however, are such that the general methods of working are similar to those which have been customary for almost hundreds of years. The Randupson process, however, is distinctly revolutionary inasmuch that the age-old methods of ramming sand in moulding boxes and drying these moulds in stoves is eliminated, and the general technique differs greatly in other respects from that normally employed.

In recent years the replacement of the normal clay bond in moulding sands with bonding material of another character has found considerable extension. The use of silica sands bonded with oil, molasses, wood extract and cereal binders has been common practice for the last 30 years, and the last decade has seen the rise of the use of silica sands bonded with colloidal clays such as bentonite. In the case of materials popularly known as oil sands, it is essential that these should be stoved after forming to shape, and in the case of bentonite-bonded sands the material is adapted only for green sand work, which naturally has its limitations for large castings.

For the purpose of comparison, it may be stated that a normal cement-sand mixture has a permeability of 800, compared with 120 for loam sand and 230 for ordinary dry sand. These figures are in the uncoated condition, and even when a coating of blacking or other facing is applied, the relative permeability is still maintained.

To give some idea of the progress which has been made with this unique method of moulding, it is in operation in some 35 foundries scattered through the world. In this country the proportion of manganese-bronze propellers being cast in moulds made by this process will probably be as high as 80 per cent. In one company alone in America, some 3,000 tons per month of ingot moulds are being made, and one steel foundry in America employs the process for over 1,200 tons of castings per month. One large foundry in the United States employs the process for all its iron castings, chiefly large drop-hammer parts up to 60 tons each in weight, and has a production of over 700 tons of iron castings per month. A large bronze foundry in the States uses the process for complicated marine castings in bronze, other than propellers, for an output of 150 tons per month, and one of the most prominent foundries for light-alloy aero-engine castings in France is using the process for light alloys. In the foundry with which the author is connected, the process is used for iron, steel, bronze and aluminium castings varying in weight from a few pounds up to 15 tons.

There is no doubt that the process is of supreme interest to every foundry doing medium and heavy castings in any alloy, and whilst the optimum technique for many classes of castings has yet to be developed, and must of necessity be left with the particular foundry where the castings are made, there is no doubt of the scope of the process beyond even its present proved wide range.

DISCUSSION

Enhanced Running Properties

In opening the discussion, the BRANCH-PRESIDENT (Mr. L. W. Bolton) said he had had the privilege of seeing the Randupson process in operation in Mr. Rowe's works and also in two large foundries in the United States. The steel-foundry operators were enthusiastic about that method of moulding. A point they made was that the running properties of the metal were enhanced when cast in cement moulds; they said it was worth another 50 deg. C. in metal temperature. He wondered if Mr. Rowe could confirm this, and whether any tests had been made to determine the difference in the running qualities in cement as compared with sand moulds. Compared with a similar casting in ordinary sand there was a noticeable difference in the surface finish, a freedom from slag inclusion and gas holes, and an absence of flash. There was much less warping, and the castings were truer to pattern. In America a wash was used on the moulds, and the particular sand used was rather less refractory than that used here. If an accident occurred to a projecting piece of a mould or core required for an important rush job, how long would it take to mend it? Finally, what would be the cost of recrushing the sand, and was it necessary to crush it into grains again or just small pieces?

MR. ROWE said there were two rather divergent factors in the running of the metal. The cement sand had a much higher permeability than ordinary sand, with the result that there was a distinct chilling effect with it. Despite that surface operation, it was a fact that a steel casting ran a lot better and was more free from marks. As to the actual flow of the metal in the cement mould, he had not noticed much difference. The fettling costs of heavy castings were considerably less, and on steel castings that advantage was particularly marked. Where biting was likely to occur the moulds were usually painted. The extremes in temperatures in U.S.A. were much greater than in this country, and it was true that setting proceeded slowly when the temperature of the foundry fell to 40 or 37 deg. F. Under such conditions local heating or the heating of the foundry had to be undertaken. With the advent of the Factories Act the factories would all have to be kept up to the minimum temperature, and they would not be such ice-houses as they had been in the past. Below 40 deg. F. the setting would be definitely slow. In regard to breakages and patching, they could run the moulds through in four to six hours if the necessity arose. Small patches could be made in an hour. As to the cost of crushing sand, a heavy blow with a sling hammer crusher would reduce it to practically its original grain size. Practically all the sand had to be broken into its original grains, and although some returns were higher, the losses were something under 5 per cent.

Choice of Sand

In reply to Mr. A. Tipper, who had said Mr. Rowe had been fair in outlining the disadvantages and advantages of the process, the LECTURER said that the usual sieve meshes for sands were as accepted by the various foundrymen's associations. One adapted the process to the silica sand most readily available locally, the cement and water content being varied to suit the local supply. On account of its salt content and the fine grain, it was not usually considered that sea sand was suitable for the process, particularly in large castings, as its clay content affected the hardening of the moulds. There was a difference of opinion between the various licensees of the process in regard to quick-setting cements. Some liked them, but his firm had never seen any advantage in using quick-setting cement against the ordinary Portland cement. In the U.S.A. quick-setting cement was used in the winter, but they went back to the ordinary cement in the summer. In regard to the contraction of the metal on a cement core, he would not like to say exactly to what depth the cement-sand core rotted. Much would depend on the quantity of cement and water used, but he could say that those contraction troubles were no greater than those which occurred with ordinary cores.

Answering questions put by Mr. J. J. Sheehan, MR. ROWE pointed out that one advantage of putting the cement-sand through the crusher was that the majority of the material extracted by desilting was dead cement. In fact, 82 per cent. of the material taken out in desilting was dead cement. There was a constant wastage of sand in a foundry, and he should say that his firm's wastage was from 10 to 15 per cent. So far as they and other licensees were concerned, they had found that, generally speaking, it was possible to go on using the sand almost indefinitely so long as 10 to 15 per cent. new sand was added and the major portion of the dead cement was removed in the process of desilting.

Pattern Wear

In reply to Mr. J. Hird, who asked if there was any trouble with clagging, if there was a greater wear and tear on the pattern owing to the sand being coarser, and if the cement sand affected the operators' hands, Mr. Rowe said that, in regard to the clagging of patterns, they had found a slightly alkaline wash useful. So far as the stripping of the paint off patterns by sand, a cellulose paint lasted very well, but he would not say that it lasted as well as it did with sand moulds. With 530 workers in his foundry, the majority of whom handled cement sand, they found that for the first few days the girls engaged in core making complained that it made the tips of their fingers sore, but when they had been working the process for a week or a fortnight, it caused no trouble whatever.

Core-Blower Use

Dealing with the question of strickling work on a mould which had already set, Mr. Rowe said the idea was to finish the job in stages; in other words, in strickling to finish off a certain part of the mould, and then carry on to the next. With most big jobs, it was usually possible so to arrange the work that those difficulties did not actually arise in practice. In reply to another member, he said that cement-sand could be and was being used for core blowing machines.

Replying to Mr. G. M. Callaghan, Mr. Rowe said that his firm did not go above 15 tons in weight of iron cast, but at the foundry of one firm in the States he had seen castings weighing 70 to 80 tons, frames for large drop hammers, bedded in cement sand in exactly the same manner except that no coke bed was required. The rubbing of moulds or cores could be done in just the same way as with dry sand or loam sand, because the sand in the cement was stronger and not so likely to break.

Drying Time and Deliveries

Questioned concerning his remark that the actual drying time did not bother a firm when they were used to the process, Mr. Rowe said he did not think he had stressed sufficiently the difference in moulding time. A little less than two months ago they were approached by a customer for the supply of a rather awkward machine-tool casting weighing 5 tons, 12 ft. long, and 3 ft. wide. They were asked if they were prepared to undertake an order for 30 castings with a guaranteed delivery of two per week. The pattern was at another foundry, and

(*Concluded on page* 98.)

Institute of British Foundrymen

WEST YORKSHIRE DINNER AND DANCE

The annual dinner and dance of the West Riding of Yorkshire Branch of the Institute of British Foundrymen took place on January 14, at the Great Northern Victoria Hotel, Bradford. Mr. A. S. Worcester presided over a gathering of some 120 members and friends. The Chairman was supported by Mrs. Worcester; by the Lord Mayor and Lady Mayoress of Bradford (Alderman and Mrs. T. J. Robinson), and by the President of the Institute (Mr. Joseph Hepworth, J.P., M.P.) and Mrs. Hepworth. Mr. T. Makemson, General Secretary of the Institute, was also present. Messages of regret for absence and expressing good wishes were received from Mr. Roy Stubbs and Mr. Victor Stobie (Past-Presidents of the Institute); Mr. H. Richardson (Principal of Bradford Technical College), and Mr. L. J. Sargeant (English Electric Company, Limited).

MR. S. W. WISE, proposing "The Visitors," said they were grateful to the Lord Mayor and Lady Mayoress for their presence, especially knowing the multitude of functions they were expected to attend in regard to Bradford's strictly local affairs. The members of the Institute recalled with appreciation the very cordial way in which the civic leaders welcomed the Institute Convention in Bradford last June. On that occasion Bradford as a community, and the West Riding foundrymen as a Branch, had been honoured by the election of Mr. Hepworth as the Institute's President. They owed much to the friendly support of Mr. Hepworth, who was one of their own members, and they were glad to see him and Mrs. Hepworth present that evening. Two supporters of the West Riding dinner in previous years had been Mr. Roy Stubbs and Mr. Victor Stobie, both Past-Presidents of the Institute, and the gathering regretted that that evening they had had to be content with messages from them. They regretted also the absence through indisposition of Principal H. Richardson, of the Bradford Technical College. Mr. Wise took the opportunity of expressing in public the thanks of the Branch to all who had given help and encouragement from outside the strict membership, and many of whom they were glad to welcome that evening.

Industrial Changes

The LORD MAYOR OF BRADFORD (Alderman Robinson), responding on behalf of the visitors, said that attendance at a dinner of foundrymen recalled memories of some big firms and famous names which had disappeared from the engineering map of Bradford—much to the city's loss. Changes, it must be recognised, were constantly occurring in industry as in other spheres, but it was regrettable to contemplate how the heavier side of engineering seemed to have left Bradford in recent years. The old firms with their extensive works had been a good source of local employment, both in themselves and in absorbing some employment of the textile industries when the latter were quiet and engineering was active. Bradford could very well do with an extension of its heavy engineering to-day.

Business conditions, he was glad to feel, were reviving in West Yorkshire after a somewhat difficult time. Statistics he had read the other day showed that West Riding trade with America in November and December—before the new Anglo-American Agreement was signed—had been more than double that of the corresponding period of the previous year, and it could be taken as almost certain that the new Trade Agreement would have an important influence in bringing better times. The foundry industry was, of course, one of vital importance to all branches of engineering. Just now, no doubt, the industry in West Yorkshire was getting some benefit from the armament programme, but he hoped the time was not far distant when prosperity would be on a much happier basis.

The PRESIDENT of the Institute (Mr. Joseph Hepworth, J.P., M.P.), proposing the toast to the West Riding of Yorkshire Branch, said, as a member of the Branch, he felt somebody else ought to have been called upon to propose this particular toast; but, as President of the Institute, it was a real pleasure to wish the West Yorkshire Branch—a very active and useful Branch—every success. It was performing most valuable work, both for its own members and for the Institute as a whole, and was carrying on the traditions of the Institute to the full by the activity of its assistance in scientific research, by its educational work and by its Papers to its monthly meetings. It was doing much in the task of improving the technique of the industry.

Combatting Overseas Competition

Continuing, Mr. Hepworth said that, in his judgment, the security of every branch of national enterprise, and the restoration of the vitality and expansive energy of commerce, depended on the early establishment of lasting peace among the nations of the world. He personally was confident that the recent achievements of the statesmen, inspired by wisdom and courage, had gone a long way toward laying the foundations of hopeful international understanding. The difficulties of the times demanded a closer co-operation between the Government and industry. While it was true that some of the large engineering industries and allied trades were busy with armament products, the general export trade must not be allowed to be overshadowed by this requirement and to dwindle. The recent speech of the Secretary of the Department of Overseas Trade on the attitude of the Government towards export trade was very encouraging and timely, in view of the unfair methods of some foreign countries. The increase of credits available to strengthen the competitive power in foreign markets to £85,000,000 would go a long way to provide fresh stimulus to the vigour of British salesmanship abroad. The export trade of this country was just as important as military preparedness, and as a nation Britain must export if it was to survive.

Mr. Hepworth appealed to all sections of British exporting industry to defend their exports in every sphere, especially when exports were being required to pay on an increasing scale for the present rearmament. The country had all the essentials for that defence and for developing export—it had human, technical and financial resources; and he believed that, with closer co-operation of all concerned, it would hold its own in the markets of the world. The Institute of British Foundrymen was playing its part, and no small part, in improving the technical knowledge of the industry and thereby helping British trade in a most important way.

Support for Reorganisation Scheme

Referring to the internal affairs of the Institute, Mr. Hepworth appealed for support by the members of the reorganisation proposals now under attention. The aim was to benefit the individual member of the Institute, and he hoped and believed the members would realise that that was the objective and would not be dissatisfied by an increase in membership fee. It had been necessary and was done solely to achieve parity with other Institutes of similar character, and he felt sure that if members accepted the increase in the proper spirit, everybody in the Institute would benefit. The only object of the reorganisation scheme was to make it thoroughly worth being a member of the Institute.

MR. S. CARTER (Senior Vice-President of the Branch), responding to the toast, paid tribute to the enthusiastic leadership of Mr. A. S. Worcester, the present Branch-President, and Branch-President at the time of the 1938 Convention. They had in Mr. Worcester a man of stability in his service to the Institute and one who had had a very great personal guiding part in the work of the weeks preceding the Conference. Thanks for that work were also due to the Branch-Secretary (Mr. Wise) and to the small band of members who shouldered by far the bulk of the job of preparing for a very notable event in the history of the Branch. The value of the Convention itself lay not only in the technical and scientific problems discussed, but also in the goodwill which it had fostered in the West Riding area between all grades of men in the foundries of the district.

The speeches concluded fairly early in the evening, and were followed by dancing to the music of George Mac and his band. Mr. P. H. Durrans, Mr. A. W. Walker (Past-Branch-President), Mr. N. W. Riley and Mr. H. A. MacColl (Junior Vice-President) acted as M.C.'s.

The Randupson Process

(*Concluded from page* 97.)

the best that firm could do was one per fortnight. His firm took the order and guaranteed two per week. They did it quite easily with the ordinary drying time of two to three days.

Non-Ferrous Applications

MR. HUDSON raised the question of the use of the process for non-ferrous casting, particularly for high phosphorus metals, and the possibility of scabbing.

MR. ROWE said that it was finding a great deal of use in non-ferrous casting, particularly in regard to phosphor bronze, manganese bronze, and gunmetal Whether the mould would be attacked would depend largely on the facing put on the mould. He did not see why one should have any more trouble with cement-sand providing it was the correct one for the job. Bentonite bonded sand was very permeable, but it had its limits, and one would not care to make a casting of 20 or 30 tons in Bentonite sand with bonded cores. Some scabbing was due to the binding material and some of it to the strength and permeability of the mould. Whatever the cause the same thing occurred in oil bonded sand. It was unusual to get anything which could be called a scab in heavy iron and steel castings.

Mould Dimensions

MR. A. A. TIMMINS asked if the mould underwent contraction during the setting period.

MR. ROWE said the point was investigated thoroughly in the early stages, and it was remarkable what little change in dimensions the mould underwent. There was a slight expansion of the mould in setting, but in every case investigated it had been negligible. In fact, it was nothing to warrant any alterations in the contraction sizes on the pattern.

On the proposition of MR. BLYTHE, seconded by MR. HALL, a hearty vote of thanks was accorded Mr. Rowe for his Paper and for answering members' questions.

The Iron and Steel Institute

The Annual Meeting of the Iron and Steel Institute will be held at the Institution of Civil Engineers, Great George Street, London, S.W., on Thursday and Friday, May 4 and 5, under the Presidency of the Rt. Hon. the Earl of Dudley, M.C. The annual dinner will take place at Grosvenor House on Thursday evening, May 4. Arrangements for the autumn meeting will be announced later.

Refining Cast Iron

By G. S. EVANS*

Mixtures of soda ash and other chemicals were used for treating molten cast iron in the ladle in England as early as 1860. Data showing 50 per cent. sulphur reductions and the beneficial effect of the refining upon the flowing powers of cupola metal, grain structure and soundness of iron castings appear in the literature of that period. However, the practice was not generally adopted at that time—possibly due to the nuisance and accident hazards incident to the use of the powdered or dusty chemicals, and the irregularity of results obtained in batch ladle treatment. However, desulphurising seems to

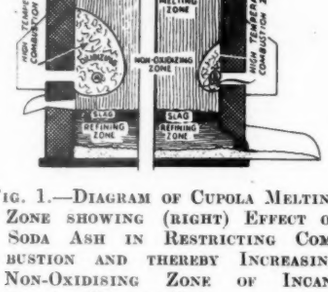


FIG. 1.—DIAGRAM OF CUPOLA MELTING ZONE SHOWING (RIGHT) EFFECT OF SODA ASH IN RESTRICTING COMBUSTION AND THEREBY INCREASING NON-OXIDISING ZONE OF INCANDESCENT COKE IN BED.

have been completely forgotten during the next 50 or 60 years.

The excess of cheap scrap coupled with the poor quality of coke available to foundries following the War caused a revival of interest in the subject, both in Germany and the United States at about the same time. Early experiments with the standard grades of sodium carbonate indicated the necessity of converting the powdery chemical into a solid form. This was necessary to facilitate handling in the foundry and to avoid injury to the workmen from dusting or by explosion resulting from the use of damp ash. After many experiments with pressed and bonded briquettes it was decided to fuse the ash and cast into 2-lb. blocks.

Development of Continuous Process

The first experiments in actual practice were carried out as batch treatment in lip or crane ladles, and the results were anything but satisfactory. While it was found that desulphurising to the extent of 40 or 60 per cent. of the sulphur present in cupola metal could be accomplished, the results were so erratic, both with respect to the composition of the treated metal and the physical properties of the finished castings, that the thing seemed hopeless. However, there was eventually evolved the process of maintaining a covering bath of a refining slag in the teapot mixer ladle. In this way it was found that by varying the quantity of soda ash used per ton, desulphurisation could be controlled more or less at will, also that the composition and physical properties of the iron were actually more uniform than before. This system or process of continually refining the metal as it flows from the cupola was later tried out in a forehearth with equally satisfactory results.

Experiments with additions of soda ash to the cupola charge were made at several foundries, along with the developments in teapot ladle treatment. It is interesting to note that the first grey iron foundry to try soda ash in the cupola in 1922 is still using it in this way. No special equipment is required—the blocks are simply added on the coke charge along with the limestone—and the greater number of foundrymen are still using soda ash only in this way.

Activity at Cupola Temperatures

The peculiar value of soda ash as a refining agent for molten cast iron is due to its power to form highly active, fluid slags at cupola melting temperatures, and to the rapidity of the reactions within the slag at these temperatures. It is this which makes it possible to refine metal from the cupola spout within the time limits and temperature losses allowable in average foundry operations.

The chemicals available for commercial use in the iron and steel industry, in the order of their activity, include: (1) sodium carbonate with a melting point of 850 deg. C.; (2) mixtures of caustic and soda ash with approximately the same melting point but with the activity reduced and the reactions prolonged by additions of carbonates; (3) caustic soda (NaOH) with a melting point of 318 deg. C.

In contact with silicates, caustic soda or the caustic:soda-ash mixture begins to react to form refining slags at very low temperatures; soda ash begins to react at about 900 deg. C. Limestone or lime begins to react to form slags at something over 1,090 deg. C. From the foregoing it is seen how the refining action of soda-ash slags at cupola temperatures may be comparable to lime slags at electric-furnace temperatures.

The reactions cause a violent boiling action which continually brings new metal into contact with the slag at the surface. In this way the refining action rapidly extends throughout the bath. Gases entrapped in the iron are expelled

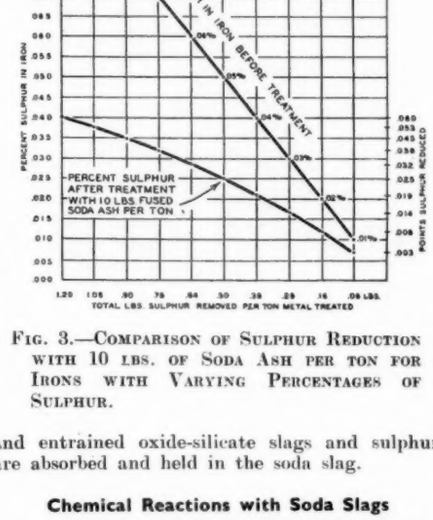

PERCENT SULPHUR IN IRON
SULPHUR IN IRON BEFORE TREATMENT
PERCENT SULPHUR AFTER TREATMENT WITH 10 LBS. FUSED SODA ASH PER TON
POINTS SULPHUR REDUCED
TOTAL LBS. SULPHUR REMOVED PER TON METAL TREATED

FIG. 3.—COMPARISON OF SULPHUR REDUCTION WITH 10 LBS. OF SODA ASH PER TON FOR IRONS WITH VARYING PERCENTAGES OF SULPHUR.

and entrained oxide-silicate slags and sulphur are absorbed and held in the soda slag.

Chemical Reactions with Soda Slags

A review of the principles underlying the desulphurising reactions with soda slags clearly demonstrates the importance of special equipment for properly carrying out the process in order to obtain uniform and efficient desulphurising. The chemical reactions going on between the metal and soda slag baths and within the slag are both varied and complicated. However, from the standpoint of the end results and for purpose of discussion they may be expressed by these simple formula:—

(1) $SiO_2 + Na_2CO_3 \rightarrow Na_2SiO_3 + CO_2$
(2) $FeS + Na_2CO_3 \rightarrow Na_2S + FeO + CO_2$
(3) $Na_2S + Fe_2O_3 \rightarrow Na2O + 2Fe + SO_2$
(4) $Na_2S + SiO_2 + Fe \rightarrow Na_2SiO_3 + FeS$

In reaction 1, "SiO_2" is taken to represent all chemical and mechanical action between the alkali slag and entrained silicates which are associated to a more or less degree with or in all molten cast iron. This is also taken to represent corrosion of the refractory lining. These are all acid-to-alkaline soda slags, and not only have a greater affinity for the alkalis than sulphur, but the very nature of their existence makes for better and more intimate contact with the slag with which they react.

The reactions with silicates not only occur at relatively faster rates, but form more stable

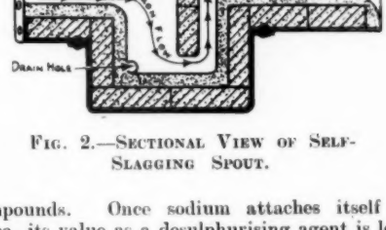


FIG. 2.—SECTIONAL VIEW OF SELF-SLAGGING SPOUT.

compounds. Once sodium attaches itself to silica, its value as a desulphurising agent is lost.

Reactions 1 and 2, the latter being taken to illustrate the process of desulphurising, including any reactions with manganese sulphide, may be considered as primary reactions. These proceed simultaneously, although at widely varying rates, depending upon the quantity and condition of acid slags present and the percentage of sulphur in the iron. For instance, with an excess of free slag, such as would result by allowing the cupola slag to flow out with the metal, reaction 1 would predominate to the practical exclusion of reaction 2.

By a simple process of reasoning, it is determined that the speed of reaction 2 (FeS to Na_2S), expressed in terms of "quantity effect," varies inversely with the percentage of sulphur in the metal. This explains why the "quantitative" reduction (lbs. sulphur removed per ton) with the same treatment under similar conditions is always greater with high-sulphur than with low-sulphur irons; also why, with similar treatment, the "percentage" sulphur reduction tends to remain always more nearly constant. For example, 10 lbs. of soda ash per ton of molten cast iron ($\frac{1}{2}$ per cent.), used under favourable conditions, will ordinarily reduce the sulphur in one treatment without external heat from 0.10 per cent. down to about 0.04 per cent., or something over 50 per cent. reduction. Also, it is found that 10 lbs. per ton used under similarly favourable conditions will reduce a 0.05 per cent. sulphur iron down to about 0.025 per cent., or an even 50 per cent. reduction. Similarly, a 0.025 per cent. iron is reduced to about 0.015 per cent., or somewhat less than 50 per cent. reduction (see Fig. 3).

Reaction 3 represents any conversion of solid sulphides held in the slag to gaseous sulphur compounds, which escape into the air, including oxidation at the slag surface. This reaction is probably of minor importance in determining the final sulphur content in ordinary ladle treatment. However, in refining cupola metal for pouring castings, where it is usually desirable to remove only 25 to 40 per cent. of the sulphur, it no doubt plays a relatively more important *rôle* in determining the final results.

Reaction 4 (Na_2S to FeS) is taken to represent all manner of reversion of sulphur from the slag back into the metal bath. The speed

* Metallurgist, Mathieson Alkali Works (Inc.), New York.

of this reaction, expressed in terms of its effect upon the percentage of sulphur in the metal bath, increases as the total of acid radicals increases in the slag. With deep baths, such as in ladle treatment, where the slag-metal surface area is small in relation to the mass of metal, this reaction is of relatively minor importance in determining the final sulphur. In shallow baths, however, as in air-furnace desulphurising, where the metal depth varies from 10 in. to zero and where the slag is acidified by roof drippings in addition to corrosion at the slag line, the final results may be affected in large part by reversion of sulphur from the slag back into the metal bath.

It will be understood that all of the reactions go on in the slag and between the slag and

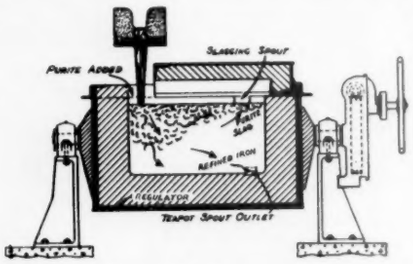


FIG. 4.—SECTIONAL VIEW OF ELONGATED TEAPOT MIXER LADLE, SHOWING HOW ENTRAINED SILICATES WHICH ARE LIQUEFIED BY THE REFINING SLAG RISE OUT OF THE BATH.

metal bath at one and the same time. The foregoing is intended simply to illustrate the combined effect of all reactions upon the metal bath at various stages during the progress of desulphurisation.

Desulphurising in Cupola Limited

Although the greater value of soda ash in the cupola comes from its action in liquefying the slag and its effect upon combustion, soda ash will generally reduce the sulphur pick-up to some extent. With average foundry mixtures, four pounds of soda ash per ton of metal, added with the regular limestone charge, will usually reduce the sulphur by 1 to 1½ points or from 0.11 per cent. to 0.095 per cent. Equal quantities used on all-scrap, high-sulphur mixtures will generally show upwards of 2 to 3 points reduction or from 0.17 to 0.14 per cent. sulphur. Under favourable conditions, greater reductions in sulphur can and are regularly being made in the cupola with the use of 8 to 12 lbs. of soda ash per ton. Owing to the diluting effect of normal slags, however, sulphur reductions, even with the larger quantities of soda ash, will be erratic and there is always the danger of foaming, which sometimes occurs with an excess volume of an extremely fluid slag. Experience has shown that 2 to 6 lbs. per ton will generally prove most economical.

In the cupola soda ash acts in two ways to produce cleaner castings; (1) it increases the fluidity and activity of the slag; (2) it acts as a catalyst in accelerating the combustion reactions. By making a more fluid slag, soda ash prevents bridging over the tuyeres and also flushes off the bed coke, making for better contact between the blast and the incandescent coke. Finally it forms a more effective refining slag over the metal in the hearth for fluxing out entrained oxide-silicate inclusions which sometimes show up as hard spots in light section castings. As a result some improvements in fluidity of the metal and machinability of the castings will be noticed.

In most cases it is found that the percentage of scrap can be moderately increased with this use in the cupola. However, where it is desired to use high scrap mixtures in the production of castings that require machining, or where the sulphur must be held within specified limits, the combined use of small quantities in the cupola, coupled with desulphurising in a teapot mixer ladle, is generally to be preferred.

Soda Ash in Ladle Treatment

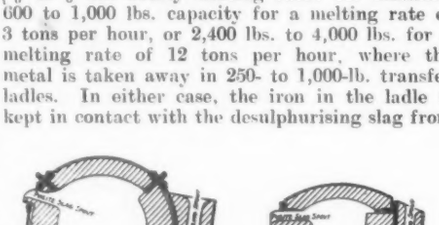
On metal for pouring heavy-section castings, where loss of temperature is of no great importance, soda ash can be used in lip ladles and the slag skimmed off after the reaction ceases. In this way upwards of 50 to 60 per cent. of the sulphur can be removed. For light-section castings and in quantity-production foundries, however, a teapot ladle or forehearth is generally required for successful refining operations; here desulphurising is usually limited to 25 to 40 per cent. of sulphur in the iron at the cupola spout.

The long delay in the adoption of soda-ash refining in the foundry industry, apart from the difficulties from dusting, was no doubt due to loss of time and labour required for skimming; loss of temperature caused by holding the iron for completion of the reaction; and erratic results obtained in ordinary lip ladles. These objections were overcome with the development of the continuous process of refining. This process provides for continually maintaining an active refining slag on the surface of a bath of molten iron in a teapot ladle or forehearth and drawing off the refined iron from the bottom. By this system temperature loss is held to a minimum and variations in composition of the metal from the cupola are levelled out by the better mixture resulting in a refining reservoir, coupled with the effects of the refining.

This system of refining cupola metal is protected by U.S. Process Patents with rights to use going with the purchase of soda ash (Purite). The process may be carried out either in a forehearth or teapot ladle, preferably the latter.

Ladle Capacity

The capacity of the mixer ladle may vary widely for the same diameter of cupola, depending upon the class of work, the capacity of the transfer ladle and the extent of desulphurising that is desired. For refining light castings where the iron is taken away in 50- or 100-lb. ladles, the mixer should have a working capacity of ⅛ to ½ the hourly melting rate: for instance, 600 to 1,000 lbs. capacity for a melting rate of 3 tons per hour, or 2,400 lbs. to 4,000 lbs. for a melting rate of 12 tons per hour, where the metal is taken away in 250- to 1,000-lb. transfer ladles. In either case, the iron in the ladle is kept in contact with the desulphurising slag from



CYLINDRICAL TEAPOT LADLE U-SHAPED TEAPOT LADLE

FIG. 5.—TWO DESIGNS OF ELONGATED LADLES.

6 to 10 min. For heavy castings the capacity may well vary from ⅓ to ¼ the hourly melting rate, thus providing an elapsed time of 12 to 15 minutes in the refining ladle.

For smaller melting rates (2 to 5 tons per hour) the new elongated ladle, covered and insulated, is essential to successful operations and the capacities given for 3 tons per hour contemplate this design.

Wherever it is practical the ladle should be kept more nearly full throughout the entire heat. In jobbing foundries, where it is sometimes necessary to pour down low for a heavy casting or to make cuts between two mixtures, the ladle should be allowed to fill up before again starting to pour. With continuous pouring, the iron level should never be allowed to drop below the half-way mark. This is necessary to ensure adequate head pressure to force entrained soda slags up out of the bath and to allow ample time for completion of the refining reactions.

Ladle Additions

Continuous flow of iron from the cupola into the mixer ladle is generally recommended, although the mixer can be successfully operated with intermittent tapping. In either case, an active desulphurising slag is maintained on the ladle throughout the duration of the heat. This is done by timing additions of the blocks of soda ash in relation to the hourly melting rate and slagging off a portion of the spent slag at

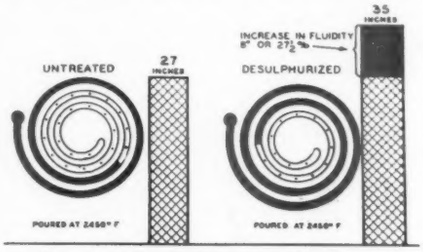


FIG. 6.—CHART SHOWING EFFECT OF DESULPHURISING WITH SODA ASH ON THE FLUIDITY OF MOLTEN CAST IRON. (AVERAGE OF 50 TESTS.)

regular intervals. In the new elongated ladles the slag is kept flowing across the ladle by pouring off a little slag just before each transfer ladle is filled or as each charge of soda ash is added at the opposite end of the ladle. In the older type of ladles a portion of the slag is poured off at intervals during the heat.

Additions of soda ash to the ladle are stopped 10 or 15 minutes before the last iron comes from the cupola—the head of slag in the ladle generally being sufficient to desulphurise the last iron—and the ladle is slagged off clean by tilting backwards just before pouring the last iron. The last slag remaining is poured off by tilting the ladle over backwards, thus keeping the soda-ash slag out of the teapot spout.

Teapot Ladle Lining

A rammed ganister lining is generally preferred for smaller capacity ladles. For capacities of 3,000 lbs. and over, ganister is used for lining the teapot spout with the body of the ladle made up of two or more courses of firebrick. The dense hard-burned type of brick, as generally used for steel ladles, which expand and cement at the joints upon being heated up by the metal, will usually give the best life. For insulation, two sheets of ⅛-in. asbestos mill-board laid against the steel shell is preferred over insulating brick.

The total cost of refining, including soda and ladle expense, will usually vary from 7½d. to 2s. 11d. per ton of metal treated. The cost of maintaining the mixer-ladle lining will average from 2½d. to 7½d. per ton or about one-third of the total. This will vary with the type of lining, the temperature, length of heat and amount of soda ash used per ton of metal.

Effect upon Physical Properties

One noticeable effect of the refining is the universal increase in deflection as measured by A.F.A. transverse test-bars. Another effect is the improvement in machinability as generally noticed with either cupola or ladle treatment. With soft iron mixtures some increase in both tensile and transverse strength will generally be noticed. These effects are typified in Table I showing test results as taken from actual practice.

The pronounced improvement in strength illustrated will be due in part (at least in this instance) to the combined effect of the reduction in silicon and the effect of higher percentages of scrap (90 per cent. compared to 60 per cent.) in

lowering total carbon and closing the grain structure. It will be noticed, however, that combined carbon was reduced from 0.53 to 0.41 per cent. This, together with the effect of the refining in washing out entrained siliceous impurities (abrasive to cutting tools) and in breaking up the size of graphite particles, no doubt accounts for the improvement in machinability which was noticeable both in the test-bars and in light castings made from the higher-scrap mixture with refining. On high-duty iron mixtures it is to be expected that less effect—sometimes no appreciable change in strength—will be noticeable, although an increase in deflection would always be expected.

TABLE I.—*Effect of Refining by Soda Ash.*

Analysis.	Regular.	Refined.*	Physical Tests.	Regular.	Refined.
	Per cent.	Per cent.			
S ..	0.128	0.088	Trans. str. 1¼ in. bar	2,900 lbs.	3,600 lbs.
C.C	0.53	0.41	Increase	—	27 per cent.
Gr ..	3.04	2.97	Defl. 12 in. centre	0.13 in.	0.16 in.
Si ..	2.47	2.29	Increase	—	23 per cent.
Mn ..	0.63	0.65	Tens. str.	11.2 tons	13.8 tons
P ..	0.54	0.46	sq. in.		
			Increase	—	24 per cent.

* 2 lbs. soda ash per ton in cupola and 5 lbs. per ton in ladle.

The refining tends to cause finer graphite particles and reduce segregation of impurities. This effect is generally, though not always, brought out by microphotographs. Here again the effect shows both with cupola and ladle treatment. One practical effect of this action of soda slags will usually be indicated, particularly at foundries making pressure castings, by a reduction in the percentage of rejects.

Fig. 6 is a chart which shows the effect of desulphurising with soda ash on the fluidity of molten cast irons. It represents the average of fifty tests. These were made in connection with regular casting operations in a cast-iron pipe foundry. The iron averaged approximately 0.1 per cent. sulphur at the cupola spout and was refined with approximately 4 lbs. of soda ash per ton, reducing the sulphur to about 0.075 per cent., or 25 per cent. reduction. Two ladles of iron, one taken direct from the cupola spout and one from the mixer ladle, were poured at the same time and allowed to cool to 1,343 deg. C., then poured into standard test-ring moulds. In this series of tests the desulphurised iron showed an average increase in fluidity of 27½ per cent. As little as 1 lb. of soda ash per ton, used in the elongated ladles, will generally effect a noticeable improvement in fluidity, even though the actual sulphur reduction is nominal. It is believed that this is due to the action of the soda slags in washing out entrained oxide silicates. Except for the first iron out of the ladle when starting up, which should be favoured by pouring into heavier castings or in nearby moulds, the increase in fluidity coming with the refining will always more than balance the loss from temperature decrease in the ladle.

Practical Value of Refining

Possibly the extent or value of the refining action can best be illustrated by outlining some of the results being obtained in regular practice to-day. When using small amounts of soda ash in the cupola charge and refining the metal from the cupola with soda ash in teapot mixer ladles, such difficult castings as radiator sections with metal lines of less than ⅛ in., and bath-tubs with ⅜ in. metal thicknesses, and such important castings as Diesel engine cylinders, are regularly being made from all scrap and ferro-silicon-manganese alloy mixtures.

The use of all-scrap mixtures in the production of specification castings is hardly to be

(*Continued in next column.*)

Solid-Fuel Cooker on "Coronation Scot"

TEST MODEL IN TRAIN FOR NEW YORK WORLD FAIR

The experimental cooking equipment installed in the kitchen-car of the "Coronation Scot" train, which is being exhibited by the London Midland & Scottish Railway Company at the World Fair in New York, is of unusual design. At the present time, cooking in British trains is done almost entirely by gas of high calorific value made by cracking fuel oil, or by electricity. Three years ago the L.M.S. Railway Company initiated research to overcome the difficulties normally associated with using solid fuel for cooking on trains; it is essential that the cooks should not have to refuel or tend the fires while cooking meals, while a high concentration of heat and a high degree of flexibility must be maintained.

The research work has been carried out by the British Coal Utilisation Research Association in conjunction with the L.M.S. Railway Company, and a group of cooker manufacturers. It

SOLID-FUEL COOKING RANGE IN THE KITCHEN CAR OF THE "CORONATION SCOT."

has been found possible to apply firing by gravity feed to heavy-duty cooking. An experimental cooker has been built and operated and now test models, of which that installed in the "Coronation Scot" train is one of the first, are being produced.

The special features of the test cooker derive from the method of firing. Smokeless fuel (coke, anthracite or steam coal) is fed by gravity on to a patented form of grate which combines the functions of preheating and the first stage of combustion. The first part of the grate is inclined, and this forms the preheating zone; there the fuel is brought to ignition temperature, before any air is admitted, by radiation from the refractory walls of the fire pot. The combustion zone is the horizontal part of the grate, which is fitted with an ash ejector. The fuel bed works as a semi-producer, and it is thick enough to ensure that the gases leaving the fire pot contain a high proportion of combustibles. Secondary combustion is obtained by preheated air introduced into the flue of the oven. The hot gases are burnt by this secondary air with a reversed flame, and so they are raised to a temperature that permits very high rates of heat transfer both to the hot-plate and to the griller. The latter is a patented device developed on behalf of the B.C.U.R.A. by Prof. Rosin, which grills very efficiently without an exposed fire. The essential feature of the Rosin grill is a refractory brick dividing the gas stream and transmitting a controlled portion of the heat to the grilling surface by re-radiation. The cooker proper is of normal type, and is designed to give all the facilities of the present gas cookers, but with an increased hot-plate capacity. Hot water for washing up and boiling water for making tea and coffee are provided by a special steam boiler, using forced steam circulation for operating the compound calorifier for hot and boiling water supply respectively. This boiler is also fed by gravity.

The foundries which co-operated in the research are:—The Falkirk Iron Company, Limited; Grangemouth Iron Company, Limited; William Green & Company (Ecclesfield), Limited; Hattersley Bros., Limited, and Jones & Campbell, Limited.

(*Continued from previous column.*)

recommended. However, that this can be done, and is actually being done at some plants, well serves to illustrate the refining action of soda slags upon molten cast iron at cupola temperature. Again, this would seem to be sufficient evidence of the practical value of the refining as a means of improving grain structure, soundness and machinability of important castings, irrespective of any savings in mixture costs.

Catalogues Received

Rotary Oil-fired Furnaces. A 16-page brochure from King, Taudevin & Gregson, Limited, of Melbourne Chambers, Cambridge Street, Sheffield, 1, deals with a relatively new type of melting furnace, known as the "Fofumi" rotary melting furnace, which is oil-fired. Initially a claim is made for its ability to make steel. On the last page technical data are given as to the times taken, the oil consumption and temperatures reached for both steel, grey iron and malleable. The outstanding feature of the furnace is the view given of the bath, associated with the ability to take samples during the operation of the furnace. In common with the rest of the foundry industry, we shall watch the progress of this furnace with much interest. In the meantime, our readers can familiarise themselves with its construction and performance by writing to Sheffield for this really interesting brochure.

Refined Iron. The North Eastern Iron Refining Company, Limited, of Stillington, Stockton-on-Tees, have devoted a 12-page pamphlet to outlining the properties of N.E. Closemix refined cylinder pig-iron. After defining the uses to which "cylinder" iron is put, reference is made to the revised B.S. Specification for Grey Iron Castings and the new one for high-duty iron. The balance of the booklet includes tabulated compositions of the five standardised grades and a very interesting graph. This graph carries as curves the transverse rupture stress, tensile strength and deflection as specified for the highest grade of B.S. Specification No. 786, and superimposed are the results obtained from N.E. Closemix covering these properties. This is quite an interesting way of recording the properties of pig-iron. The pamphlet is available to our readers on request.

Automatic Emergency Valves. A leaflet received from Hopkinsons, Limited, of Huddersfield, describes, illustrates and dimensions a new type of automatic emergency press-button-actuated closing valve. The number of the leaflet is 3,810.

Alloy Cast Iron*

By TOM SHANKS

Cast iron is a remarkable material, being both cheap and good; unfortunately, because of its comparative cheapness, people are apt to overlook it for much more costly metals when difficult conditions have to be met. Moreover, far too often it is to be found that, due to lack of knowledge, people debase cast iron by bad treatment, so that many of its valuable properties are stinted or reduced. The ease of preparation, however, and the adoption to rigid formation without extended treatment make cast iron the most valuable metal that society has at its disposal. For many years, those who have recognised the advantages of cast iron have been endeavouring to develop some of its good features and extend to it some other properties by varying its normal metalloids, or by introducing other alloying materials.

Cast iron, or readily castable iron, contains a number of more or less naturally attached elements. These are carbon, silicon, manganese, sulphur and phosphorus. It is these elements which make iron castable. All are usually found in the raw material—pig-iron—all can be varied in the course of preparation, and all exert a considerable effect on the final properties of the cast iron.

Ferrite

Ferrite is structurally pure iron, but in a cast iron it usually has some other constituents dissolved in it. Iron exists in different forms, which, while having the same appearance, have considerably different properties. First, there is alpha iron, the usual soft iron which exists at normal temperature; secondly, there is gamma iron, better known as austenitic iron, which is soft, non-magnetic, and (most important) absorbs iron carbide up to 1.7 per cent. carbon. The austenitic variety is normally stable at temperatures above 700 deg. C., but by the addition of alloys, notably chromium and nickel, austenite can be made stable at normal temperature.

Carbon

Carbon, which is normally present in a cast iron from 3 to 4 per cent. (depending on the melting and other constituents of the iron), reduces the melting point to a castable temperature. Carbon exists in several forms in cast iron; primarily, it unites with the iron to form iron carbide, which is iron combined with 6.7 per cent. carbon. This carbide is soluble in pure austenitic iron up to almost 26 per cent., but is thrown out of the solid iron as it cools, until about 700 deg. C., when iron can only hold about 12¾ per cent. of carbide. Below this temperature the iron containing carbide breaks up to form a new material called pearlite. The carbon in molten iron which is not combined with iron will exist in the solid iron afterwards as primary graphitic carbon. The iron carbide which is free when the austenite solidifies, and also that carbide which has been dissolved, but is deposited during cooling, can also break down during cooling to form iron and secondary graphite. This secondary graphite is very fine and the preferable form to have in iron castings.

Alloy Elements

These affect the iron-carbon system in two ways. They influence the ferrite matrix normally by going into solution, either wholly or in part. This influence is easily explained by showing that these alloys, which enter into solid solution in the ferrite, appear to have the effect of taking the place of iron carbide. They harden the actual iron, reduce solubility for carbide, and, with sufficient addition, make it entirely ferritic or austenitic, *i.e.*, having an effect on the iron as if it were raised to over 700 deg. C. Alloying elements may also or alternatively act on the carbide, either to cause it to disassociate into ferrite and graphite (the carbide is not actually a stable condition) or to stabilise the carbide, usually by detracting from the graphitising elements.

Silicon

Silicon exists as iron silicide, entering into solution in the iron. It is normally present from 0.5 to 4 per cent. There is considerable loss in silicon in that charged, and also in any additions made, as it is readily oxidised. Silicon is a strong graphitiser. It increases the fluidity of the metal, reduces the effect of chill in the metal, hardens the ferrite slightly, and increases the grain size, coarseness, and causes segregation. From 5 to 6 per cent. silicon makes the iron entirely ferritic, *i.e.*, reduces the carbide so that all the carbon is found as primary and secondary graphite.

Phosphorus

Phosphorus is generally obtained from high-phosphoric pig. Further additions can be made to the charge as ferro-phosphorus. Phosphorus forms Fe_3P with iron. In turn, Fe_3P forms a compound eutectic with cementite, solidifying at 960 deg. C. This may persist to a much lower temperature in the presence of free cementite. The phosphide, which is hard and weak, separates around the crystal boundaries and generally segregates. The effect of phosphorus is to increase fluidity and fluid temperature range, to resist wear, and reduce strength.

Manganese

Manganese is normally present from 0.4 to 1.8 per cent. in base pig-iron. Additions can be made by lump 80 per cent. ferro-manganese to the charge. There is considerable loss during melting, both in the manganese naturally present and in the material added. Manganese forms manganese sulphide and reduces iron sulphide to do this (thereby removing the effects of the iron sulphide). Manganese increases the fluidity and freezing range of the iron, thereby tending to increase the size of the graphite; it also appears to stabilise the carbide. Manganese de-oxidises the iron, reduces gas solubility, increases hardness and strength slightly, reduces shrinkage, and increases the effect of chill without embrittling.

Sulphur

Sulphur is normally present from 0.05 to 0.2 per cent., but, generally, it is an unwanted constituent in iron. In the melting process there is usually a gain, due to pick-up from the fuel. Iron sulphide is not soluble in iron and forms thin films around the crystals. It is very brittle, hard, and reducing in strength, while its effects are to increase carbide and shrinkage. Manganese has a great affinity for sulphur, and reduces iron sulphide to form manganese sulphide.

Chromium

Chromium is normally added as crushed ferro-chrome (60 per cent. Cr with 6 per cent. C maximum) to the ladle; and, generally, the addition is from 0.3 to 1 per cent. only. Chromium has a marked effect on the iron, quite small additions having a concentrated action. It seems to form a double carbide of iron, and it stabilises and hardens the carbide. In this connection, it is directly opposite to, and approximately of the same power as, silicon, the graphitising effect of 1 per cent. silicon being offset by 1 per cent. of chromium. Chromium is an inexpensive addition and very effective. Additions are readily oxidised, and allowance has to be made for loss. Chromium reduces the Ar_1 point. By stabilising the carbide and hardening the matrix, it greatly increases the hardness of the iron. It also increases considerably the effect of chill on the iron. It is most usefully employed with nickel or copper, as it firms the iron and counteracts the graphitising action of these alloys.

Nickel

Nickel can be added as nickel bearing scrap, "F" nickel shot, or by means of the various alloys available. In the higher proportions no important metallic losses are sustained. Normally structure refining conditions are made by adding "F" shot in the ladle. This element appears to be soluble at least up to 40 per cent. in cast iron, but in ordinary practice it seldom exceeds 15 per cent. Within this range quite a number of different types of iron can be produced. A progressive hardening is attendant upon increased nickel additions, but at the same time it graphitises the carbide. By shortening the depositing range, it maintains the graphite as a fine structure, resulting in a denser and a more nearly homogeneous condition. Table I indicates the effect of increasing additions of nickel.

TABLE I.—*Influence of Nickel on Cast Iron.*

Per cent.	Effect.
0.0 to 2	Firming matrix; refining and reducing carbide.
2 to 4	Increasing the hardness; finally exhibiting a sorbitic structure.
4 to 8	Yields martensitic iron; maximum hardness *circa* 480 Br. at about 6 per cent.
8 to 14	Iron becoming austenitic; very hard, gradually softening; seldom used.
14 to 18	Austenitic range, soft, readily machinable; non-magnetic.
18 to 25	Special austenitic irons; soft, non-magnetic and resistant.
30 to 40	Austenitic; soft; resistant; low expansion; magnetic.

Molybdenum

This element is usually added as crushed ferro-molybdenum (having 60 per cent. Mo) to the ladle. The normal amount added is 0.3 to 0.5 per cent., but may reach 1 per cent. Molybdenum within the range of normal additions seems to go entirely into solution in the iron. It is an expensive addition, but is most effective, although its use is not yet fully understood. It appears to go into solution in the ferrite, hardening this without having a graphitising action. Summarised, it may be said to refine the graphite; refine the grain generally; stabilise the carbide; tend to make the pearlite sorbitic; equalise the structure throughout heavy sections; increase the chill effect without incorporating brittleness; reduce contraction and shrinkage; and improve the mechanical properties generally, particularly in low carbon irons. It is most advantageous for chill effect and wear resistance.

Copper

The element is simple to add in the light solid form to the ladle, but small metallic losses are shown. Normal additions range from 0.5 to 3.5 per cent. Actually, it is directly soluble in pure molten iron up to 7½ per cent., but in cast iron it is of the order of from 3 to 5 per cent., with carbon from 4.3 to 3 per cent. Copper is soluble in alpha iron at 850 deg. C. to 1.7 per cent., and in pearlite to 0.6 per cent. Unless controlled, primary copper will separate from molten iron in globules, and secondary copper from austenite in microscopic globules. Carbon, manganese and nickel, by lowering the Ar_1 point, reduce the proportion of copper dissolved, whilst silicon and chromium raise it and increase solubility.

Copper acts as a graphitiser to the extent of about one-third the strength of silicon, and only

(*Concluded on page* 104.)

* Abstracted from an Address given to the Falkirk Section of the Scottish Branch of the Institute of British Foundrymen.

Core Drying and Shop Layout

USEFUL POINTERS DISCLOSED AT MANCHESTER MEETING

The Paper on "Foundry Drying and Modern Coreshop Layout" evoked an informative discussion when it was presented earlier in the session to the Lancashire Branch of the Institute of British Foundrymen. An abstract of the Paper was reproduced in our December 8 issue.

The discussion was opened by MR. A. PHILLIPS, who thought that Mr. Smith could have elaborated a little more on the advantages of mould drying in the floor. With the mould drier, he said, one of the important advantages was that the hot gases were blown into the mould and also through the runners, while they could be allowed to escape through vents. This was one of the best methods of drying. With the old method of putting a firebox or grating into the mould, the dampness was drawn to the runner, especially if the latter were a long way from the face of the mould.

Speed of Drying and Cracked Moulds

The question of natural-draught *versus* forced-draught drying stoves called for a good deal of consideration. There was much to be said for both processes, but there was one matter on which he did not quite agree with Mr. Smith. The lecturer had discussed a quick drying process; at the beginning there was very quick drying of a specially large mould, in a stove. His own view was that there was severe cracking of moulds if they were dried too quickly at the beginning. Had Mr. Smith experienced similar trouble?

The plants Mr. Smith had shown had been used for, say, specialised work. Many foundrymen still had to use the old-fashioned drying methods, involving the use of racks. These were brought to the edges of the benches, where girls put the cores on the racks, and then by using jack trucks, they were pushed into the stove. This system had a great deal in its favour.

In the case of the continuous drying stove, it was necessary in the majority of cases to carry the core to the conveyor or the stove, for which a girl had to be employed. If the girl had a rack at the side of the bench, she put them on the rack and a labourer was employed for pushing a batch into the stove.

Core-Sand Reclamation

Another matter in regard to the coreshop layout was the original sand entering the shop. Economies could be made in a coreshop by using a large proportion of the old oil-sand, especially in aluminium foundry practice. Even for some smaller iron castings it was possible to re-use a large percentage of the sand. This could be mixed with the new sand, with a general economy both in the used sand and the core oil. He did not notice anything in the illustrations which enabled any of the plants to reclaim used sand.

Mr. Smith had stated that he used a small-gauge railway truck to take the cores into the foundry. Would the lecturer consider rubber-tyred trucks to be of more advantage for that purpose than a shaky narrow-gauge railway?

Uniform Temperature in Stoves

All members had not got foundries in which they could have a special type of stove, but if a foundry had to make a variety of cores, could Mr. Smith tell them what stove would give a similar uniform temperature at one side of the stove as the other? He referred to controlled temperature, by means of draught chambers or pipes which incorporated shutters or the like.

Another point upon which he would like information concerned the inhibition of rust on metal inserts in moulds or cores. There was a certain amount of moisture in the moulds from the cores, but he thought most of the detrimental moisture was evolved from the gases. Could Mr. Smith state which was the best fuel to use, and which would assist in avoiding the presence of rust on metal inserts in the cores?

Floor Drying Problems

MR. SMITH, referring to floor drying, said he quite agreed with Mr. Phillips' observations that there could be no comparison between floor drying methods with a mould drier under proper conditions, and drying by the ordinary brazier or fire bucket. No matter how long the latter was used, there was not the same effect as with the forced draught which the mould drier provided.

With regard to short-period drying, he presumed Mr. Phillips' main concern was whether there was a damaged mould through rushing up too quickly. With the forced-draught method, it would be recalled, he had mentioned that there was forced draught in a concentrated form. A further detail with regard to short-period firing, which he had not mentioned previously, was that the fire was built up as quickly as possible and the furnace forced up to capacity with chimney dampers partly closed. When the temperature reached over 100 deg. C., it was necessary to open the exhaust dampers fully for two to five minutes in order to release the pressure of steam, otherwise drying would cease due to the presence of moisture. But one did not register as high stove temperature normally with forced-draught short-period firing as was frequently obtained with a natural draught.

What Forced Draught Involves

He had exhibited a comparative chart showing the stove temperature with natural-draught firing at 375 deg. C., but with the forced draught it did not go beyond 265 deg. C. The difference between stove and mould maximum temperatures with natural draught was 175 deg. C., but with forced draught (pressure drying) the mould temperatures followed stove temperatures closely, and the difference in maximum temperatures was only 15 deg. C. When a high stove-temperature was reached before heat penetration into the sand commenced, moulds were likely to crack. It was necessary to differentiate between forced draught as such and forced draught *plus* pressure drying. Forced draught, technically, meant that sufficient air was "pushed" through the fire to give complete combustion of the fuel, but that was not efficient foundry drying. For efficient drying it was necessary to drive into the stove air equivalent to the total air capacity of the stove every few minutes. That was actually "pressure drying." With that system the mould was penetrated by the heat very quickly and brought up to a point where water boiled. Then the steam came out with the rising stove temperature and was carried off quickly. So long as the steam was carried away, there was no detriment to the temperature rise afterwards.

One type of mould—the loam mould—which contained a large proportion of clay, could not be rushed to the same extent as in the case of a water-bonded sand. He knew steel moulds which were being dried at temperatures up to 480 deg. C. and they were not damaged in any way. The main point about the short-period drying was that provision must be made for the moisture to escape, and then, having taken the bulk of the moisture away in a short period of time, to allow the small amount left to soak away slowly. He could only make the statement that this had been actually proved in practice.

Examples from Practice

He had omitted to state one point which he wished to make regarding pressure drying. He had referred to a foundry using forced-draught furnaces of a type where the proportion of auxiliary air used was very small. With these stoves the maximum temperatures required were approximately 100 deg. C. higher than other stoves in the same foundry using real pressure drying. A further example of the efficacy of this method was provided by the drying of a very large loam core 18 ft. long by 16 ft. high in a stove specially built for it, at a temperature just over 100 deg. C. The furnace of this stove was of normal type, and the stove could be run at ordinary temperatures by merely rearranging the air dampers.

Mr. Phillips had mentioned that many foundrymen had old-fashioned stoves and did not want to build new ones. The graph illustrating the Paper demonstrated the difference between natural draught and the forced draught in an old type stove. Certainly the stove had a modern natural-draught furnace *outside* it, but there was no alteration made except to exchange the fire box and use the forced draught. This could be done to any existing stove. There was no necessity to pull down a stove which was in good condition.

Suitability of the Rack Explained

There was nothing against rack drying. The main difficulty was that, if adopted on a large scale, defects began to be noticed. For instance, some years ago a large automobile foundry used that type of drying, taking up a very large amount of valuable space for the racks, and the heat from large quantities of cores lying about made the shop distinctly uncomfortable. In the case of a small shop with one or two racks, there would be no inconvenience. There was no reason why a stationary stove with rack drying should not be used, and until the continuous system came into vogue there was nothing better. Sometimes foundrymen thought they could use a continuous stove to advantage when perhaps it was not worth while. He had, on several occasions, advised people that they did not really require a continuous stove. The governing factor was mainly the volume of output. Many large foundries only had a small core output. The character of the coreshop did not depend on the size of the foundry, but upon the amount of core-making which was done.

Sand Reclamation

With regard to reclaiming old sand, one well-known firm used about 75 per cent. old sand, but they did not mix it with new sand. They used the new sand for facing important cores, and the old sand for less important cores, or for backing. Another up-to-date foundry had recently installed a very complete plant for reclaiming its knock-out core sand. In this shop 70 per cent. of the core sand was returned, cleaned, sifted, and in appearance was similar to the new dried sand used. The cost of this plant must be high, and although very satisfactory in operation it might be too expensive for many firms to instal.

As to the use of rubber-tyred trucks, if a jack truck and racks were being used for green cores, then rubber-tyred trucks suggested themselves, because stillage racks were bound to get a certain amount of bumping. When, however, the core was properly dried it was possible for it to receive a fair amount of ill usage without any damage. In the case referred to the railway track went all over the foundry. Cores had to cross a roadway, and would probably get more bumping there if the truck had the rubber tyres than if it travelled over rails. That was the reason the light railway was used for dried core transport in the particular shop.

Uniform Stove Temperature

He was going to be frank and admit that one did not get an *absolutely* uniform temperature; but the variation in temperature that existed with a good forced-draught system was not suffi-

cient to be detrimental to any core. Furthermore, it was possible to dry large and small cores together without any risk of damage to the small cores.

He did not wish it to be understood that he advocated the forced-draught stove merely as such, but usually with the natural draught there were very wide variations of temperature. A job near the fire might have twice as much heat as if it was placed in a corner. This state of things should not obtain with forced draught; the variations in temperature were relatively small.

As far as the drying of large and small cores was concerned, with a good forced-draught system it would be possible to place the cores in any desired position, and whether they were large or small there would be efficient drying; the only consideration was that a large core would take longer to become dried through than a smaller one.

Choice of Fuel and Rust Inhibition

To avoid rust on chills, a fuel must be used which was essentially dry. It so happened that a statement on this point was made in the American Paper,* to which reference had been previously made.

"*The choice of fuel*: The importance of dry air for a core had already been shown. The fuel should be chosen accordingly. The largest amount of burnable material in any fuel is carbon, which becomes a carbon dioxide after burning. In most fuels, the next amount of burnable material is hydrogen. When hydrogen is burned, it becomes hydrogen oxide, and that is water.

"A fuel which contains carbon only is ideal because it gives an absolutely dry heat. Coke, therefore, is the ideal fuel."

That was an American comment on fuel. He might add that the velocity of air passing through the stove under forced draught allowed no condensation, and so such a system precluded any rust on the chills.

MR. J. A. REYNOLDS wished for information concerning automatic stokers. He gathered from the lecturer that in automatic stoking some of the advantages of forced draught were lost. Was it possible to apply a low-pressure fan to an automatically fired stove? Another point upon which he desired enlightenment was with regard to the use of coke *versus* gas in a small stove. One firm advocated a gas-fired stove with pressure-blown air. Would that overcome the difficulty? The lecturer had stated that gas was very dear, and that some friend of his had been astounded as to its cost. Was the stove referred to using forced draught?

A Transport Problem

Another point was with regard to the frictionless bogie. Where it was desired to use a turntable, and it was impossible to use a crane in a lateral direction, was it possible to embody a turntable so as to divert cores from one line into the next one and into the next stove? What advantage had a steel band conveyor over the gravity type?

It had not been made clear to him how the continuous stove was fired and what fuel was used.

MR. SMITH observed that the difficulty of applying excess air in sufficient volume to create a resistance in the stove was the tendency to create back pressure in the automatic stoker. He did not mean to infer by that that it could not be done, but the commercial aspect of the question ought always to be borne in mind.

The answer to the question of the gas stove with air pressure would be on similar lines. He had some figures with regard to a special burner with pressure air on a stove 15 ft. by 12 ft. It took 10 hours to get the stove up to 230 deg. C. Actually, the average consumption in a stove 15 ft. by 12 ft. was 1,700 cub. ft. of gas per hour fired hard for 10 hours, to get up to 230 deg. C., after which a soaking out period followed. Moulds put in on Monday night were taken out on Wednesday afternoon. With a good forced-draught coke-fired system the moulds put in on Monday evening would be taken out on Tuesday morning.

Application of Frictionless Bogies

Frictionless bogies had a limited field of usefulness. They were ideal for a reciprocating motion, such as getting heavy loads of moulds in and out of stoves, but it was not feasible to run them an indefinite distance. The normal travel was 20 to 50 per cent. more than its own length. It would be possible, but not convenient, to use a turntable. For example, with a 16-ft. bogie, its axles would be about 9 ft. 6 in. centres; it would be necessary to have a turntable about 11 ft. dia. to take it. There were actually 16-ft. bogies running 35 ft., but normally they ran 20 to 24 ft. With a turntable it would be possible to turn it round, and run it back at right angles, or any angle desired, the same distance, and to reverse again. As a general proposition, it was not adaptable for that purpose.

Core Conveyors

Dealing with steel bands *versus* gravity conveyors, a steel band would convey the most fragile green core without damage. A steel band was mechanically propelled, while a roller conveyor, whether it was level or gravity, was almost entirely hand-propelled. It was not as free from vibration as the steel band; but if it were specially well made, *i.e.*, costing about 50 per cent. more than a standard roller conveyor, it was adequate for most cores. Some cores were too intricate for a roller conveyor to be used.

Several factors influenced the use of roller conveyors. In the first place, the green cores often had to come down the shop and round the corner. One could not take a steel band round a bend. The same consideration applied to bringing the core plates back. On the other hand, any mechanical type of conveyor had a certain amount of wear and tear. In the type of roller conveyor shown the users maintained there was practically no wear and tear. He did not, however, wish to be understood as stating that this method was applicable to every core-shop. He thought it would be conceded, from the illustrations, that every shop was entirely different in its lay-out, and yet each was adaptable to the job for which it was designed.

He had built stoves for either gas or oil firing and for coke; but, without question, under ordinary circumstances coke was the best fuel.

Drying a Gas-Engine Crankcase

MR. H. HAYNES said Mr. Smith had stated that coke was the best fuel. Some years ago, THE FOUNDRY TRADE JOURNAL published a photograph of a mould 10 ft. by 5 ft. by 3 ft. deep, which was dried by producer gas, and the casting had been made the same day. Producer gas was a very cheap way of drying moulds. He had seen moulds 20 ft. long, 8 ft. wide, and 4 ft. deep, dried in 5 hrs. Mr. Smith had also stated that his method took 24 hours to dry a somewhat similar mould. He agreed this was satisfactory for repetition work, but for foundry floor work he disagreed. Another advantage as regards producer gas was in the case of a big mould where there were a lot of tables to be made up. It helped to produce the work quicker.

MR. SMITH would not have thought it possible to dry a mould of the size stated with producer gas in 5 hrs. Producer gas must give a moist heat as compared with coke fuel. He assumed the mould was dried right through

MR. HAYNES said that the section of the metal was 3½ in. on the bottom and 1½ in. on the sides. It was dried in 5 hrs., and took 22 tons of metal to cast.

MR. SMITH asked how much sand there was in it, and MR. HAYNES replied that the job was in the floor, not in a box.

MR. SMITH said that there were any number of jobs which were merely skin-dried with a blowpipe. Even in stoves there were degrees of drying. There were forced-draught stoves locally which would dry three batches of moulds 8 in. deep in 8 hrs., but such drying would not be sufficient for all jobs. They would probably dry about 2½ in. to 3 in. in from the mould face. When a mould was dried in the floor, even with a mould drier, it was not dried right through. It was simply dried a certain distance back from the mould face. What regulated the amount of drying was the question of how far it was necessary to go for safe casting.

MR. HAYNES pointed out that the casting he referred to was perfectly clean and had no scabs. It was for a crankcase for a gas engine.

MR. SMITH explained that plenty of jobs made in the floor could safely be cast "green." It was possible to skin-dry to a depth of ½ in. or a depth of 1 ft.; but when a mould was put in a stove, it became bone-dry right through. That was a totally different proposition. A firm he had in mind had some jobs which could be stoved in 3 hrs.; but when they were doing some other jobs, they had to be absolutely bone-dry right through to the box, and that took 8 hours in the stoves.

Alloy Cast Iron

(*Concluded from page* 102.)

slightly weaker than nickel. It has not the coarsening effect of silicon. It strengthens the matrix and equalises the grain size in a similar way to nickel.

Primary copper (over the solubility factor) coats the inclusions, rendering them fluid and so reduces the formation of primary graphite, thus refining the grain and the graphite. Secondary copper has no effect on graphitisation, but seems to increase the effect of chill. An addition of 1 per cent. nickel increases the solubility of copper by about 0.5 per cent. The principal use of copper is to replace silicon or to balance the carburising effect of chromium. Its effect is to break down the free carbide, *i.e.*, to soften irons where cementite is present. It would harden ferrite and irons without carbide.

The above elements are commercially used in a number of combinations to establish properties of direct importance to users of iron castings for specialised application.

The speaker then went on to the various mechanical properties of iron castings, and showed how, from the foregoing information, the strength, wear, corrosion and heat resistances could be increased.

For stated requirements or conditions the effects of the various alloying metals and combinations of them were considered, together with their cost.

A number of slides were shown to illustrate typical applications and when and where alloying elements could be used to advantage. There was also a series of slides giving tabulated results from a number of tests, so that the effect of various proportions and ratios of alloy additions could be readily seen.

During the discussion which followed, many of those present showed they were interested in the melting of the base iron for the addition, and in the making of cast iron of high tensile strength as required by the new B.S. Specification.

Grateful acknowledgements for the loan of slides were made to Dr. J. W. Donaldson; the Mond Nickel Company, and the Copper Development Association.

The address concluded with a vote of thanks accorded on the proposition of the Chairman.

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* American Foundrymen's Association preprint. No. 38-27. "What Happens to a Core in a Core Oven," by Jaspar Willsea.

Of interest to Pig Iron Users

THE STANTON METALLURGICAL SERVICE

The Stanton Company believe that a mutual policy of collaboration in more scientific and better methods of manufacture, can do much to widen the field for cast-iron products.

The Stanton Company therefore offer to all those engaged in the Iron Foundry Trades the free advisory service of specialists in metallurgical practice and technique.

This service takes the form of analyses and tests by the Company's Research Department on castings submitted to them, and constructive suggestions if the desired results are not being attained.

Where there are difficulties in works practice which can best be investigated on the spot, the service provides for a personal visit from a Stanton metallurgical expert, who will collaborate with the foundry staff.

THE STANTON IRONWORKS COMPANY LIMITED
Near NOTTINGHAM

The Largest Producers of Foundry Pig Iron (for Sale) in Great Britain

The Week's News in Brief

Trade Talk

A NEW WORKS is to be built by the International Harvester Company of Great Britain, Limited, at Doncaster.

THE NEW CRANSLEY IRON & STEEL COMPANY, LIMITED, of Kettering, relit their No. 1 blast furnace on Thursday of last week.

BRECKNELL, WILLIS & COMPANY, LIMITED, of London and Bristol, are to build a new foundry at Chard, Somerset.

CORNERCROFT, LIMITED, Coventry, makers of wheel discs, tyre and wheel covers, etc., are acquiring the Northern Aircraft & Engineering Products, Limited, of Lancs.

THE CLYDESDALE STEELWORKS of Stewarts and Lloyds, Limited, Mossend, resumed work on January 23, after having been closed since Christmas.

PHILIP & SON, LIMITED, shipbuilders, engineers and ironfounders, of Dartmouth, celebrated their 80th year in business by a dinner at Dartmouth on January 20.

IT IS NOW ESTIMATED that the steel plant of the Steel Corporation of Bengal, Limited, should start during the autumn of this year and be in full operation in the following spring.

WORK IS TO BEGIN immediately on the biggest factory yet built on the Scottish Industrial Estate at Hillington, near Glasgow, and is to cost £60,400 to build. It will have a floor space of 86,000 sq. ft.

THE NORTHERN ALUMINIUM COMPANY, LIMITED, have installed a plant at their Banbury works for the production of extruded sections of greater length and larger cross-section than have hitherto been available in this country.

THE STAFF of Carron Company held their annual dinner in the Dobbie Hall, Larbert, Falkirk, on Saturday evening. Mr. George Pate, O.B.E., J.P., presided over a company of 208. The counting house staff held a dance in Falkirk on the previous evening, when 150 were present.

Wage Reduction Agreed in Light-Castings Trade

The negotiations between employers and the trade unions in connection with the proposed reduction in wages of workers engaged in the manufacture of rainwater and soil goods reached the final stages last Thursday, when it was agreed that the workers should accept a "cut" of 5 per cent. from the percentage bonus as from Monday of this week. The agreement was reached at a meeting held in Glasgow between representatives of the National Light Castings Ironfounders' Federation and the three trade unions—the Stove, Grate and General Metal Workers, the National Union of Foundry Workers, and the Ironfounding Workers' Association.

The original suggestion of the employers was for a reduction of 12½ per cent. on basic wage rates. After consultation with the men's representatives, however, this was reduced to 7½ per cent. The trade-union leaders recommended the acceptance of this reduction, but the men, after a ballot, voted against it. A new conference was then called, and took place in Glasgow last Thursday. The following official statement was issued:—

> "Representatives of the National Light Castings Ironfounders' Federation, along with the Trade Unions affected, agreed on an immediate reduction of 5 per cent. from the percentage bonus on rainwater and soil goods, to operate in respect of work done as from Monday, January 23, leaving it open to the Federation to approach the Unions in the future in respect of the balance of 2½ per cent. in the event of experience demonstrating the necessity for such a step."

The Scottish districts involved are Falkirk, Bonnybridge, Bo'ness and Glasgow.

TWENTY-NINE EMPLOYEES of R. A. Lister & Company, Limited, of Dursley, who have over 35 years' service with the firm, will be presented with long-service certificates next Saturday by the chairman, Mr. Percy Lister. Sixteen of them have over 40 years' service. Mr. R. Hewish holds the record with 55 years' uninterrupted service.

A BANQUET was given to the staff of General Refractories, Limited, last Saturday, to celebrate the silver jubilee of the business and also the 60th birthday of Mr. Frank S. Russell, chairman of the company. Mr. Russell said that it was his desire to devote much more of his time in the future to political work and to work on behalf of the unemployed in the distressed areas of South Wales. He had been associated with the industry for 45 years, and it was now his intention, whilst retaining a seat on the board, to relinquish the chairmanship at an early date in favour of Sir Ronald Matthews, the present vice-chairman.

Personal

MR. PETER BENNETT, President of the Federation of British Industries, has been nominated for a second term of office.

MR. DESMOND H. BIGGLESTON, a member of the firm of H. M. Biggleston & Sons, ironfounders, of Canterbury, was married last Thursday to Miss Margaret Reeves, of Whitstable.

MR. J. K. NEWSOM DAVIS, a managing director of the Davis Gas Stove Company, Limited, and son of the late Mr. Harold Newsom Davis, has been appointed a director of Radiation, Limited.

MR. T. NIMMO DEWAR gave a short address to members of the Council of the Institute of British Foundrymen at last Saturday's meeting in Birmingham. He was made President of the South African Branch on its inauguration two years ago.

Wills

EMPSALL, J. H., of Bradford, brassfounder £16,880

SHORT, E. W., a director of Short Bros., Limited, shipbuilders, Pallion, Sunderland £3,426

BELLISS, JOHN, of Edgbaston, Birmingham, a director of Belliss & Morcom, Limited, engineers £129,647

FOWLER, SIR HENRY, chief mechanical engineer to the L.M.S. Railway, 1925-30, and a Past-President of the Institution of Mechanical Engineers ... £18,198

JONES, SIR WILLIAM JOHN, Warlingham, Surrey, a former director of Dorman, Long & Company, Limited, and deputy-controller of steel production during the war £76,132

Obituary

MR. DANIEL SMITH, founder in 1880 of Daniel Smith Limited, engineers and founders, of Wolverhampton, has died, aged 85.

MR. GEORGE BRADLEY FISH, of Mansfield, died suddenly on January 12, at the age of 60 years. He was secretary of J. Maude & Company, Limited, engineers and ironfounders, Mansfield.

Company Reports

Vaughan Bros. (Drop Forgings), Limited.—Interim dividend of 10 per cent.

British Piston Ring Company, Limited.—Ordinary interim dividend of 5 per cent.

Peter Brotherhood, Limited.—Interim dividend on the ordinary shares of 8 per cent.

John Baker & Bessemer, Limited.—Dividend on the 6 per cent. cumulative preference shares for the half-year ended December 31.

Head, Wrightson & Company, Limited.—Interim dividend on the ordinary shares of 2½ per cent. on account of the year ending April 30, 1939.

Leyland Motors, Limited.—Profit for the twelve months to September 30, 1938, after making provision for taxation and contingencies and transferring £100,000 to general reserve, £325,850; dividend on the ordinary shares of 25 per cent.

Contracts Open

Bacup, February 6.—Iron castings for 12 months ending March 31, 1940, for the Borough Council. Mr. H. Guffogg, borough engineer, Municipal Offices, Bacup.

Coventry, February 6.—Iron castings for 12 months from April 1, for the General Works and Housing Committees of the City Council. Mr. E. H. Ford, city engineer, Council House, Coventry.

Fareham, January 26.—Iron pipes and specials for 12 months from April 1, for the Urban District Council. The Surveyor, Westbury Manor, Fareham.

Guildford, February 6.—Iron castings for six months from April 1, for the Corporation. Mr. J. W. Hipwood, borough surveyor, Municipal Offices, Guildford.

Hull, February 6.—Castings (ferrous and non-ferrous), steel and steel sheets, for the Transport Department. The General Manager, Transport Department, Ferensway, Hull.

Kidderminster, February 18.—Cast-iron pipes and other iron castings during the year ending March 31, 1940, for the Corporation. Mr. J. Hawcroft, borough engineer, 110, Mill Street, Kidderminster.

Long Eaton, February 11.—Cast-iron pipes for 12 months from April 1, for the Urban District Council. Mr. H. Raven, engineer, Town Hall, Long Eaton.

Margate, February 15.—Wrought-iron tubing and fittings (bituminous coated), cast-iron pipes and special castings, firebars and castings, copper pipes (light gauge) and fittings, etc., for 12 months ending March 31, 1940, for the Borough Council. Mr. A. E. Crisp, waterworks engineer, 58, Victoria Road, Margate.

Naas, February 23.—Supply and erection of a 20-ton weighbridge, for the Kildare County Council. The County Surveyor, Courthouse, Naas, Eire.

Swansea, February 7.—Iron and steel, etc., for 12 months from April 1, for the Borough Council. The Borough Engineer, Guildhall, Swansea.

New Company

(From the Register compiled by Jordan & Sons, Limited, Company Registration Agents, 116 to 118, Chancery Lane, London, W.C.2.)

Robert Hardman & Bros. (Rockliffe), Limited, Rockliffe Foundry, Rockliffe Road, Bacup.—Capital £500. Ironfounders, etc. Directors: R. T. and A. J. Hardman.

Forthcoming Events

FEBRUARY 2.

Institute of Metals (Birmingham Section):—"Defects in Non-Ferrous Ingots," Paper by G. W. Bailey, at James Watt Memorial Institute, Birmingham, at 7 p.m.

Institution of Mechanical Engineers (Scottish Branch):—Paper on "Diesel Engine Development," at Royal Technical College, Glasgow, at 7.30 p.m.

FEBRUARY 3.

Institution of Mechanical Engineers:—"Concerning Cylinder Bore Wear," Paper by Alex Taub, at the Institution, Storey's Gate, London, S.W.1, at 6 p.m.

Institute of British Foundrymen

FEBRUARY 1.

London Branch:—Debate on "Castings *versus* Welded Structures," at Charing Cross Hotel, London, at 8 p.m.

FEBRUARY 2.

East Anglian Section:—Annual dinner and smoking concert, at Crown and Anchor Hotel, Ipswich, at 7 p.m.

Sheffield and District Branch:—"Notes on Steel-Foundry Practice," Paper by S. Leetch, at Royal Victoria Hotel, Sheffield, at 7.30 p.m.

FEBRUARY 3.

Birmingham, Coventry and West Midlands Branch:—"The Randupson Process," Paper by F. W. Rowe, at James Watt Memorial Institute, Birmingham, at 7.30 p.m.

FEBRUARY 4.

Lancashire Branch:—Annual whist drive, dinner and dance, at the Grand Hotel, Manchester, from 4 p.m. to 11.45 p.m.

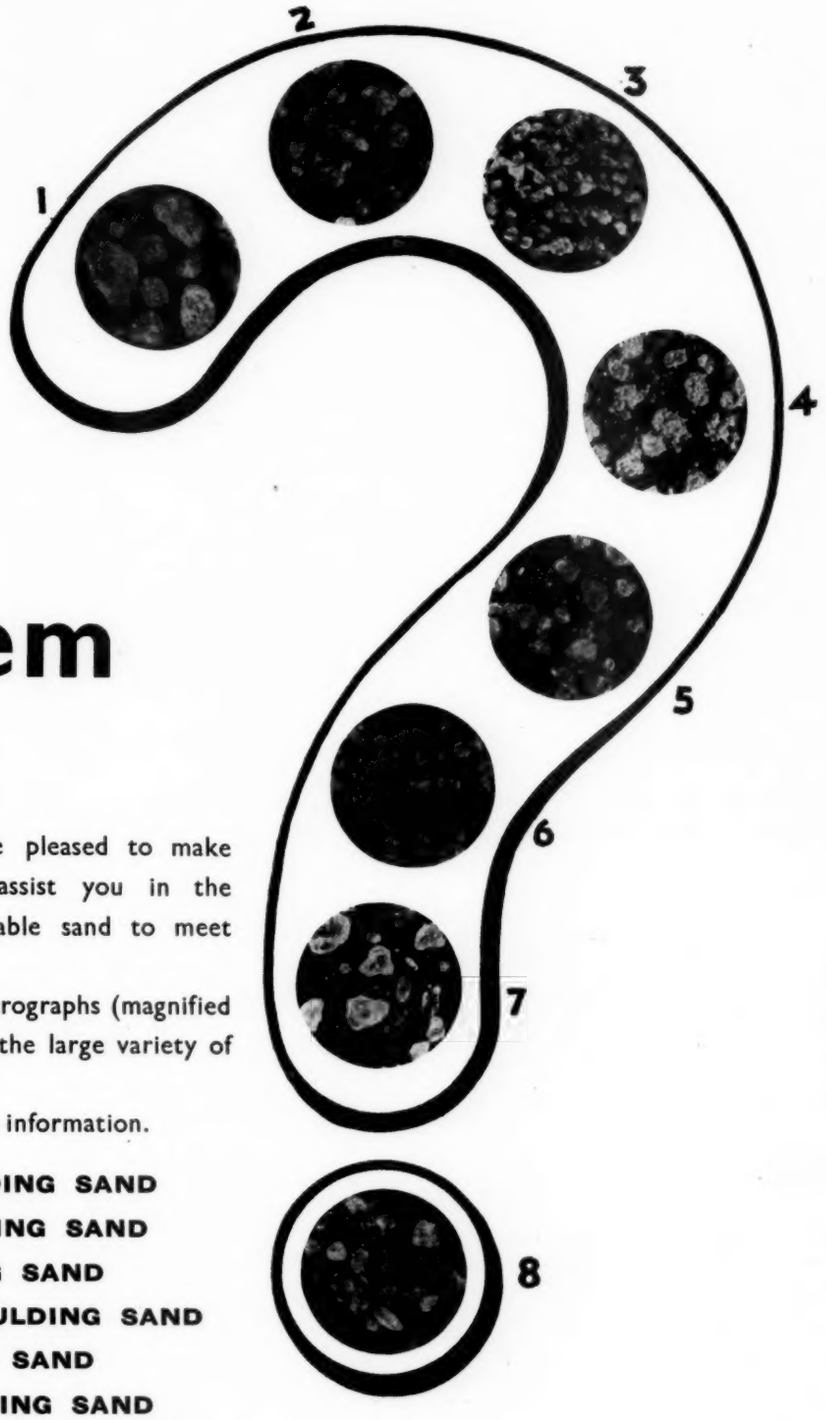
Wales and Monmouth Branch:—"Some Jobbing Problems," Paper by F. G. Jackson, at University College, Cardiff, at 6 p.m.

The Institute of Vitreous Enamellers

FEBRUARY 2.

Northern Section:—"Mill-Room Practice," Paper by A. G. Read, at Queen's Hotel, Manchester, at 7.30 p.m.

Have you a sand problem



Our Technical Staff will be pleased to make recommendations and to assist you in the selection of the most suitable sand to meet your exact requirements.

The accompanying photo-micrographs (magnified 25 diameters) show eight of the large variety of sands which we produce.

Please write us for detailed information.

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5. ZENITH MOULDING SAND
6. MANSFIELD MOULDING SAND
7. CAVE BROWN MOULDING SAND
8. No. 60 MOULDING SAND

Please write for full particulars to:—

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Telephone: Sheffield 31113 (6 *lines*). **GENEFAX HOUSE, SHEFFIELD, 10** *Telegrams: "Genefax, Sheffield."*

Raw Material Markets

Although there has been a slight improvement in the rate at which consumers of foundry pig-iron have placed inquiries for additional supplies, business continues to be disappointing. In many cases consumers' stocks are being steadily drawn upon and it is expected that there will be further renewals of contracts over the next month or two. Orders for rearmament requirements are keeping many works well employed.

Pig-Iron

MIDDLESBROUGH.—Although the current output of foundry iron is comparatively small, it is quite adequate to meet the requirements of the consumers. Many local foundries have poorly-filled order-books and, of course, do not wish to accumulate stocks to an excessive degree. On the whole, the outlook is improving, but it had been hoped that the reductions in prices would have had a more pronounced effect on trade. No. 3 Cleveland G.M.B. foundry iron is quoted at 99s. per ton in Middlesbrough and Falkirk, 101s. on the North-East Coast, and 102s. on Clydeside. These prices are subject to 5s. rebate.

A better tone is noticeable in the hematite section of the market and consumption is increasing. As yet, the effect of this has only been to expand the call for contract deliveries and not much new business is going through. Local exporters do not attempt to hide their disappointment at the commercial results of Mr. Chamberlain's recent visit to Rome; a resumption of hematite trade with Italy would come as a boon to them, but it does not appear that much progress was made in this respect to trade matters at the negotiations. East Coast mixed numbers are quoted at 120s. on the North-East Coast, 125s. 6d. in Sheffield, and 131s. in the Midlands, less 5s. per ton rebate.

LANCASHIRE.—The demand for foundry iron continues to show only small improvement. Working conditions at the consuming plants are variable; there is not a very good outlook for the textile-machinery makers, who have poorly-filled order-books, and existing contracts more than cover foundry iron requirements. Many of the jobbing foundries, too, are badly situated for work, but machine-tool manufacturers are busy both on home and export trade. Heavy electrical concerns and other branches of the specialised engineering trades are all active and are taking up good tonnages of iron. On the whole, it would appear that prospects for the iron trade in this area are more favourable, but new orders are disappointing. For delivery to users in the Lancashire price zone, offers of Derbyshire and Staffordshire No. 3 foundry iron are on the basis of 104s., with Northamptonshire No. 3 at 102s. 6d. and Derbyshire forge iron at from 101s. to 103s. per ton, according to the class of consumer. Business in hematite remains on the quiet side. West Coast mixed numbers are quoted at 128s. 6d., with East Coast material at 128s., both delivered equal to Manchester.

MIDLANDS.—Business in high-phosphorus iron continues to be on a hand-to-mouth basis and the number of long-term contracts falls well below expectations. The light-castings foundries are still badly placed for work and until there is an improvement in this section the outlook cannot be viewed with optimism. At present, this branch is less active than usual at this time of the year and short time is general. Another unsatisfactory feature of this trade as far as the producers of iron are concerned is that in most cases consumers carried over substantial tonnages under old contracts at the end of the year. For delivery to Birmingham and Black Country stations, Derbyshire No. 3 iron is quoted at 101s., with Northamptonshire at 98s. 6d. There is little or no improvement in the hematite section of the trade and new orders are very difficult to obtain. Generally, new contracts are for small tonnages for early delivery. There is no doubt that consumers are better employed than was the case during the final quarter of 1938, but it will be a considerable time before the better conditions are reflected among the producers, owing to the heavy stocks that are being carried at the consuming plants, in addition to substantial deliveries still to be taken up in respect of last year's contracts. The brightest feature in this area is the low-phosphorus iron trade and good tonnages are regularly changing hands. The price varies from £5 5s. to £6 per ton, delivered.

SCOTLAND.—Although there is little indication of any increase in the demand for Scottish iron, there has been an expansion in the call for Continental foundry iron, which is offered at 89s. per ton at Falkirk. Consumers are, of course, attracted by the low rates ruling for foreign iron. No. 1 Scottish foundry iron is quoted at 108s., with No. 3 at 105s. 6d., f.o.t. furnaces. The light-castings trade remains subdued, while labour disputes are not helping matters. Working time at the local steelworks is fairly good, but they are mostly covered for a good time ahead for their pig-iron requirements. Prices of steel-making irons are as follow: Hematite mixed numbers, 120s. 6d.; basic, 92s. 6d., less 5s. rebate, delivered steelworks here.

Coke

There has been quite a satisfactory demand for foundry coke of late and many ovens are working to capacity in order to meet the orders. Deliveries have, in some cases, fallen slightly behind schedule. On the whole, trade is confined to deliveries before the end of the first quarter of the year and there has been little business beyond this period. For delivery to Birmingham and Black Country stations, the minimum price of Durham and Welsh cokes is 50s. 6d. per ton.

Steel

The demand for structural steel continues to fall short of producers' expectations, although there have recently been indications of a slight improvement. The lower prices have not been instrumental in bringing forth additional orders, as makers had hoped would have been the case. Prices are fixed for deliveries up to the end of June and as a result consumers are not anxious to enter into further long-term contracts. The sheet trade is still on the quiet side, but orders in connection with the Government's plans to provide the entire civil population with air-raid shelters have already made some difference to this section, while there should shortly be a pronounced increase in trade when the A.R.P. schemes get into proper working order. Building trade orders for steel bars are still quiet. The latest returns of the building trade issued by the Ministry of Labour indicate that there was a substantial fall in the plans passed during the month of December. The total for that month was £6,866,000, as compared with £9,890,300 in December, 1937. The total for the whole of 1938 is 12.2 per cent. lower than in the previous year.

Scrap

Improvement in working time at certain steelworks has resulted in a better demand for scrap in some areas, but, on the whole, trade is still quiet. Some consumers have recently called for deliveries under existing contracts on a freer scale, but merchants are still experiencing difficulty in disposing of most grades of scrap. In Scotland, there have been reductions in prices of from 8s. 6d. to 10s. for wrought-iron scrap.

Metals

Foreign affairs have continued to exert a considerable influence over the trend of events in the commodity markets. Dr. Schacht's relinquishing of his position as President of the Reichsbank was taken as a further indication that the German currency position was by no means sound, and this caused much apprehension in commercial circles. The war in Spain continues to drag on, and, in view of the fact that the insurgents are now gaining strategical positions which may well bring the war to an early closure, it is feared that more complications may arise from the Italian threat as to the consequences of any interference on the part of France. Meanwhile, there is little forward demand for metals on account of the uncertainty of the outlook.

Copper.—The Anaconda copper concern last week announced that, as a result of the continued lack of demand from American consumers, it was bringing into operation a scheme for the reduction of its output. The Kennecott Corporation has since announced a reduction of 10 per cent. in its production. The decision of these concerns has come as no surprise, in view of the poor demand and the rising stocks. M. Edgar Sengier, managing director of the Union Minière du Haut Katanga, left France for New York on January 18. Somewhat naturally, his visit has given rise to the suggestion that there will be a further cut in the quotas. Business in this country during the past few days has been very quiet, consumers showing little interest in forward dates. There are so many disturbing factors in the political world that large-scale trade is not likely to be favoured until the outlook is clearer.

Metal Exchange quotations were as follow :—

Cash.—Thursday, £43 to £43 1s. 3d.; Friday, £42 18s. 9d. to £43; Monday, £42 8s. 9d. to £42 10s.; Tuesday, £42 6s. 3d. to £42 8s. 9d.; Wednesday, £42 5s. to £42 6s. 3d.

Three Months.—Thursday, £43 6s. 3d. to £43 7s. 6d.; Friday, £43 6s. 3d. to £43 7s. 6d.; Monday, £42 15s. to £42 16s. 3d.; Tuesday, £42 12s. 6d. to £42 15s.; Wednesday, £42 10s. to £42 11s. 3d.

Tin.—The demand for tin of late has been very small, and little business has been done. The outlook is still doubtful, and the continued quietness of the tinplate industry, both in this country and in the United States, is disappointing, as it had been hoped that by now this important working-up trade would have better order-books. Mr. A. Ellinger has been appointed assistant manager of the tin buffer stock executive. He was at one time connected with the Metallgesellschaft and more recently with the Montan Metallhandel, the Dutch concern. Disagreement with the policy of the Federated Malay States Government as regards the prospecting of new tin lands was expressed by Mr. C. L. Green, mining member of the Federal Council and a director of Petaling Tin, in his speech at the company's annual meeting at Ipoh. Mr. Green declared that the slow progress made by the Government in releasing adequate areas of land for prospecting had been very disappointing, and that the prospects of the industry in this respect were far from reassuring.

Official quotations were as follow :—

Cash.—Thursday, £216 7s. 6d. to £216 12s. 6d.; Friday, £216 5s. to £216 7s. 6d.; Monday, £213 15s. to £214; Tuesday, £214 10s. to £214 12s. 6d.; Wednesday, £213 5s. to £213 10s.

Three Months.—Thursday, £217 to £217 5s.; Friday, £216 15s. to £216 17s. 6d.; Monday, £214 15s. to £215; Tuesday, £215 5s. to £215 10s.; Wednesday, £213 15s. to £214.

Spelter.—Despite the recent news that a considerable tonnage of this metal will be required in connection with the Government's A.R.P. plans, a quiet tone has ruled on the market. No doubt, the international situation has been responsible for the relapse in prices, as the outlook generally is not unsatisfactory.

Daily market prices :—

Ordinary.—Thursday, £13 16s. 3d.; Friday, £13 11s. 3d.; Monday, £13 7s. 6d.; Tuesday, £13 11s. 3d.; Wednesday, £13 8s. 9d.

Lead.—Steady conditions have prevailed in this market during the past week. The weekly report issued by Brandeis, Goldschmidt & Company, Limited, states that "an advance in the price has been prevented by free offering and an ample supply of prompt lead. There has been no falling off in the orders received by cable makers, and the lead requirements in that direction promise to be well maintained. In the pipe, sheet and plant trades, the position is not so favourable and, as yet, there is little indication of a turn for the better. It seems that the statistical position will show a moderate improvement as a result of a reduction in Australian production."

Day-to-day quotations :—

Soft Foreign (Prompt).—Thursday, £14 8s. 9d.; Friday, £14 5s.; Monday, £14; Tuesday, £14 2s. 6d.; Wednesday, £14 6s. 3d.

Scrap.—The demand for non-ferrous scrap metals has been at a very low ebb, and it would not seem likely that any improvement will be noticeable until the political situation eases.

Approximate selling prices for old metal:—New aluminium cuttings, £70; rolled, £54 to £55; cast, £32; foil, £80. Copper, £38 to £42; braziery, £34 to £36. Brass (clean), £20 to £24. Zinc, £10. Lead, £13 10s. Gunmetal, £37.

IT IS REPORTED that the Government is taking steps to ascertain the stocks of raw and semi-finished copper in this country as at the end of 1938. The position, it is said, will be reviewed every three months. It is suggested also that steps are already being taken to secure information on zinc stocks. The Government desire to have a more accurate guide than has hitherto existed to the supplies which would be available in the case of a national emergency.